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The least significant difference (LSD P<0.05), seen at the bottom of data tables gives an indication of the treatment difference that could occur by chance. NS indicates that there is no difference between the treatments. The size of the LSD can be used to compare treatment results and values must differ by more than this value for the difference to be statistically significant.

So, it is more likely (95%) that the differences are due to the treatments, and not by chance (5%).

Of course, we may be prepared to accept a lower probability (80%) or chance that 2 treatments are different, and so in some cases a non-significant result may still be useful.

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The Board of the Hart Field-Site Group Inc would also like to acknowledge the significant contribution of site collaborators and donors of inputs, equipment and labour.

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The Hart Board welcome you as a visitor to Hart and value your feedback and questions.

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Diary dates

Hart Calendar 2013

Getting The Crop In
Wednesday 6th March 2013

HART FIELD DAY
Tuesday 17th September 2013

Winter Walk
Tuesday 23rd July 2013

Spring Twilight Walk
Tuesday 15th October 2013

Hart Field Day 2012

Comparison of wheat varieties

Key Findings

- Axe was the highest yielding commercially available hard wheat at 2.47t/ha
- Corack was the highest yielding APW variety at 2.34t/ha
- All wheat varieties were above the 11.5% level required for Hard 2

Why do the trial?

To compare the performance of new wheat varieties and lines against the current industry standards.

How was it done?

Plot size	1.4m x 10m	**Fertiliser**	DAP + Zn 2% @ 70kg/ha
Seeding date	1st June 2012		UAN @ 80L/ha, 24th July

The trial was a randomised complete block design with 3 replicates and 27 varieties. Fungicides were applied as necessary to keep the crop canopy free of disease ie. stripe rust.

Plot edge rows were removed prior to harvest. All plots were assessed for grain yield, protein, test weight and screenings with a 2.0 mm screen.

Results

Grain yields at Hart in 2012 ranged from 1.55t/ha for Lincoln, up to 2.47t/ha for Axe (Table 1). The average wheat yield at Hart in 2012 was 1.94t/ha.

Emu Rock, Corack, Mace and AGT Katana also performed well and were not significantly different to Axe.

Wheat grain protein levels ranged from 11.5% (Phantom) to 13.6% (Estoc) with an average of 12.5%.

Screening levels ranged from 2.4% (Axe) to 10.6% (Shield) with a trial average of 5.6%. These results are higher than grower screening levels in the district and it is unknown what might have contributed to this. There were a significant number of varieties with screening levels above the maximum for APW and Hard of 5%.

The varieties producing test weight values lower than 74kg/hL, the minimum required for maximum grade, were Correll, Lincoln and Orion. The varieties that were just under 74kg/hL included Shield, Yitpi and Magenta. Test weight values for the overall site averaged only 76.1kg/hL and so could be considered lower than normal and need to be viewed with some caution.

Table 1. Grain yield (t/ha), protein (%), test weight (kg/hL) and screenings (%) of wheat varieties at Hart in 2012.

Quality	Variety	Grain yield (t/ha)	% of Gladius	Protein (%)	% of Gladius	Test weight (kg/hL)	% of Gladius	Screenings (%)	% of Gladius
AH	Axe	2.47	125	11.8	93	75.0	100	2.4	69
	Catalina	1.89	96	12.9	102	78.5	104	4.9	140
	Clearfield JNZ	1.73	88	12.3	97	76.1	101	7.4	211
	Correll	1.83	93	12.5	98	72.9	97	6.9	197
	Emu Rock (IGW3167)	2.36	120	11.6	91	77.2	103	3.4	97
	Derrimut	1.99	101	12.5	98	78.2	104	4.7	134
	Gladius	**1.97**	**100**	**12.7**	**100**	**75.2**	**100**	**3.5**	**100**
	Grenade CL Plus (RAC1689R)	1.81	92	12.5	98	77.2	103	3.7	106
	AGT Katana	2.16	110	12.1	95	78.4	104	5.2	149
	Lincoln	1.55	79	12.4	97	73.1	97	8.2	234
	Mace	2.22	113	12.9	101	77.1	102	3.4	97
	Peake	2.08	106	12.7	100	77.5	103	4.4	126
	Phantom (LPB07-1040)	1.80	92	11.5	90	76.6	102	7.3	209
	Shield (RAC1718)	2.04	104	12.0	94	73.9	98	10.6	303
	Wallup (VV4978-1)	2.04	104	12.5	98	77.2	103	6.9	197
	Yitpi	1.82	92	13.0	102	73.6	98	9.1	260
	Cobra	1.83	93	12.8	101	75.8	101	4.8	137
APW	Espada	1.86	94	12.5	98	74.8	99	4.2	120
	Estoc	1.83	93	13.6	107	80.2	107	5.4	154
	Impose CL Plus	1.65	84	13.3	104	76.6	102	3.2	91
	Kord CL Plus	1.79	91	12.9	101	76.8	102	3.4	97
	Scout	2.03	103	12.1	95	76.7	102	6.5	186
	Corack (VW2316)	2.34	119	11.7	92	78.2	104	3.7	106
ASW	Magenta	1.69	86	12.7	100	73.9	98	8.8	251
SOFT	Impala (C51021)	1.77	90	13.0	102	74.4	99	8.7	249
	Orion	1.74	89	13.0	102	71.1	94	5.9	169
Unclasified	LPB08-1799	2.04	104	12.5	98	78.6	105	5.2	149
	Site mean	1.94	98	12.5	98	76.1	101	5.6	161
	LSD (0.05)	0.33	17	1.3	10	3.4	5	4.6	131

Comparison of barley varieties

Key Findings

- Fathom (WI4483) was the highest yielding feed variety at 3.3t/ha
- Commander and Buloke were the highest yielding malt varieties, averaging 2.94t/ha
- Oxford produced the highest screenings of 37.4%
- Commander was the only malt variety to meet the minimum retention rate

Why do the trial?

To compare the performance of new barley varieties and lines against the current industry standards.

How was it done?

Plot size	1.4m x 10m	**Fertiliser**	DAP Zn 2% @ 70kg/ha
Seeding date	1st June 2012		UAN @ 80L/ha, 24th July

The trial was a randomised complete block design with 3 replicates and 24 varieties. Fungicides were applied as necessary to keep the crop canopy free of disease ie. net blotch.

Plot edge rows were removed prior to harvest. All plots were assessed for grain yield, protein, test weight, screenings with a 2.2 mm screen and retention with a 2.5 mm screen.

Results

Fathom, Fleet, Hindmarsh and Keel were the highest yielding feed barley varieties at Hart in 2012, averaging 3.2t/ha (Table 1). The average yield across all feed varieties was 2.78t/ha. The lowest yielding feed variety was Grange at 2.05t/ha.

The highest yielding malt varieties were Commander and Buloke, averaging 2.94t/ha (Table 1). The average yield across all malt varieties was 2.61t/ha. The lowest yielding malt variety was Westminster at 1.75t/ha.

Grain protein ranged between 10.1% for Keel and 12.5% for Oxford. The only variety to fall outside the allowable protein range of 9 to 12% for malt barley was Westminster at 13.3%. Grain protein generally decreased with increasing grain yields.

All malt varieties exceeded the minimum test weight specification of 65kg/hl. All feed varieties exceeded the minimum test weight specification for F1 feed barley of 62.5kg/hl.

Barley screenings at the site were generally high with an average of 23.9%. Oxford produced the highest screenings at 37.4%.

Commander and WI4593 were the only varieties that produced a retention rate greater than the required 70% for malt barley. Westminster had the lowest retention at 46%.

Table 1: Grain yield (t/ha), protein (%), test weight (kg/hL), screenings and retention (%) of barley varieties at Hart in 2012.

Quality	Variety	**Grain yield (t/ha)**	% of Sloop SA	**Protein (%)**	% of Sloop SA	**Test weight (kg/hL)**	% of Sloop SA	**Screenings (%)**	% of Sloop SA	**Retention (%)**	% of Sloop SA
Feed	Barque	2.63	102	12.1	102	64.5	92	23.2	97	65.2	104
	Capstan	2.84	111	11.0	92	67.0	95	31.6	133	38.3	61
	Fathom (WI4483)	3.30	128	10.3	87	69.1	98	18.0	76	75.2	120
	Fleet	3.22	125	10.9	92	67.4	96	19.2	81	70.0	111
	Hindmarsh	3.19	124	10.4	87	72.1	102	22.6	95	63.7	101
	Keel	3.08	120	10.1	85	67.6	96	16.7	70	70.4	112
	Maritime	2.80	109	11.5	97	69.9	99	5.4	23	91.3	145
	Oxford	2.15	84	12.5	105	72.5	103	37.4	157	50.8	81
	Scope CL	2.55	99	11.3	95	71.4	101	23.7	100	64.8	103
Malt	Buloke	2.93	114	10.6	89	71.0	101	22.1	93	61.5	98
	Commander	2.95	115	10.5	88	69.8	99	14.6	61	76.8	122
	Flagship	2.73	106	10.6	89	72.6	103	27.8	117	62.6	100
	Flinders	2.65	103	11.7	98	71.3	101	26.7	112	55.1	88
	Gairdner	2.70	105	11.6	97	71.5	102	27.4	115	52.2	83
	Schooner	2.58	100	11.7	98	72.0	102	27.2	114	64.0	102
	SloopSA	**2.57**	**100**	**11.9**	**100**	**70.4**	**100**	**23.8**	**100**	**62.8**	**100**
	Westminster	1.75	68	13.3	112	71.2	101	30.8	129	46.0	73
	Bass (WARBAR2315)	2.46	96	12.5	105	69.9	99	21.8	92	62.9	100
	Navigator (WI4262)	2.97	116	11.2	94	70.3	100	22.0	92	67.5	107
Unclassified	IGB1101	2.78	108	11.1	93	69.6	99	29.2	123	52.1	83
	Grange	2.05	80	12.4	104	71.6	102	35.6	150	50.0	80
	Skipper (WI4446)	2.71	105	11.3	95	69.2	98	25.8	108	55.2	88
	Wimmera (VBO432)	2.30	89	12.3	103	71.9	102	24.7	104	67.5	107
	WI4593	2.95	115	11.3	95	69.1	98	15.6	66	76.0	121
	Site mean	2.70	105	11.4	96	70.2	100	23.9	100	62.6	100
	LSD (0.05)	0.38	15	1.1	9	2.1	3.0	9.6	40	16.8	27

Comparison of durum varieties

Key findings

- The grain yield results were very low, averaging 0.88t/ha for the trial
- Test weight values were low and screening values high for all varieties

Why do the trial?

To compare the performance of new durum varieties and lines against the current industry standards.

How was it done?

Plot size	1.4m x 10m	**Fertiliser**	DAP + Zn 2% @ 70kg/ha
Seeding date	1st June 2012		UAN @ 80L/ha, 24th July

The trial was a randomised complete block design with 3 replicates and 7 varieties.

Plot edge rows were removed prior to harvest.

All plots were assessed for grain yield, protein, test weight and screenings with a 2.0 mm screen.

Results

WID802 was the highest yielding durum variety at Hart in 2012 (1.22t/ha) although all varieties in the trial produced statistically similar yields with an average of 0.88t/ha (Table 1).

Compared to wheat and barley trials the durum grain yields were significantly lower, due to crown rot and greater sensitivity to a dry finish. This is also highlighted by the low test weight values, averaging only 51.6kg/hL, and high screening values, averaging 35%.

As a result proteins were all above 13.0%.

Table 1. Grain yield (t/ha), protein (%), test weight (kg/hL), and screenings (%) for durum varieties at Hart in 2012.

Variety	Grain yield (t/ha)	% of Tamaroi	Protein (%)	% of Tamaroi	Test weight (kg/hL)	% of Tamaroi	Screenings (%)	% of Tamaroi
Caparoi	0.77	122	13.9	101	50.8	96	33.2	98
Hyperno	1.06	168	14.0	102	51.6	98	32.3	96
Saintly	0.99	157	14.1	102	50.7	96	41.7	124
Tamaroi	**0.63**	**100**	**13.8**	**100**	**52.9**	**100**	**33.7**	**100**
Tjilkuri (WID801)	0.65	103	14.2	103	53.3	101	31.8	94
WID802	1.22	194	13.4	97	49.3	93	37.2	110
Yawa (WID803)	0.85	135	13.9	100	52.5	99	35.3	105
Site mean	0.88	140	13.9	101	51.6	98	35.0	104
LSD (0.05)	ns	ns	ns	ns	ns	ns	10	30

Comparison of triticale varieties

Key findings

- Chopper (1.38t/ha) was the highest yielding triticale variety at Hart for the second year in a row

Why do the trial?

To compare the performance of new triticale varieties and lines against the current industry standards.

How was it done?

Plot size	1.4m x 10m	**Fertiliser**	DAP + Zn 2% @ 70kg/ha
Seeding date	1st June 2012		UAN @ 80L/ha, 24th July

The trial was a randomised complete block design with 3 replicates and 11 varieties.

Plot edge rows were removed prior to harvest.

All plots were assessed for grain yield, protein, test weight and screenings with a 2.0mm screen.

Results

Chopper (1.38t/ha) was the highest yielding triticale variety at Hart for the second year in a row (Table 1). The average grain yield of the remaining varieties was 0.88t/ha.

Triticale protein ranged from 12.2% (Chopper) to 14.1% (Canobolas) and the average across all varieties was 13.0%. Protein tended to decrease with increasing grain yield.

Berkshire (63.4kg/hL), Canobolas (62.3kg/hL) and Goanna (61.3kg/hL) produced the highest test weights with the average being only 58.0kg/hL. This was the second year in a row that Berkshire had one of the highest test weights.

Screenings ranged from 16.0% (Chopper) to 34.3% (Berkshire) and averaged a high level of 27.3%.

Table 1. Grain yield (t/ha), protein (%), test weight (kg/hL), and screenings (%) for triticale varieties at Hart in 2012.

Variety	Grain yield (t/ha)	% of Tahara	Protein (%)	% of Tahara	Test weight (kg/hL)	% of Tahara	Screenings (%)	% of Tahara
Berkshire	0.99	111	13.1	102	63.4	113	34.3	131
Bogong	0.85	96	13.5	105	57.1	102	32.1	123
Canobolas	0.84	94	14.1	109	62.3	111	28.5	109
Chopper	1.38	155	12.2	95	57.3	102	16.0	61
Goanna	0.89	100	13.0	101	61.3	109	27.5	105
Hawkeye	1.03	116	12.7	98	59.7	107	25.5	97
Jaywick	0.85	96	13.1	102	55.2	99	23.8	91
Rufus	0.76	85	13.1	102	52.8	94	31.6	121
Tahara	**0.89**	**100**	**12.9**	**100**	**56.0**	**100**	**26.2**	**100**
Tuckerbox	0.86	97	12.5	97	55.8	100	28.6	109
Yowie	0.84	94	12.9	100	56.8	101	25.7	98
Site mean	0.93	104	13.0	101	58.0	104	27.3	104
LSD (0.05)	0.2	5	0.7	6	2.9	4	6.9	26

Comparison of oat varieties

Key findings

- The grain varieties Dunnart (2.28t/ha) and Possum (2.17t/ha) were the highest yielding oat varieties at Hart in 2012

Why do the trial?

To compare the grain yield performance of new oat varieties and lines against the current industry standards.

How was it done?

Plot size	1.4m x 10m	**Fertiliser**	DAP Zn 2% @ 80kg/ha UAN @ 80L/ha, 24th July
Seeding date	13th June 2012		

The trial was a randomised complete block design with 3 replicates and 20 varieties.

Variety	Grain Yield (t/ha)	% of Wallaroo
Wallaroo	**1.81**	**100**
Brusher	1.95	108
Mulgara	1.96	109
Wintaroo	1.66	92
Kangaroo	1.15	64
Tungoo	1.18	65
Tammar	1.03	57
Forester	1.88	104
Kojonup	1.90	105
Yallara	2.05	113
Mitika	2.14	118
Dunnart	2.28	126
Possum	2.17	120
Potoroo	1.99	110
Echidna	2.11	116
Bannister	2.16	119
Euro	2.02	111
Wombat	1.95	108
03142-62	2.09	116
WAOAT2332	2.10	116
Site mean	1.88	104
LSD (0.05)	0.3	17

Table 1. Grain yield (t/ha) for oat varieties at Hart in 2012.

Results

The grain varieties Dunnart (2.28t/ha) and Possum (2.17t/ha) were the highest yielding oat varieties at Hart in 2012 (Table 1). The hay varieties Tammar (1.03t/ha), Kangaroo (1.15t/ha) and Tungoo (1.18t/ha) were the lowest yielding varieties.

The average yield of hay varieties (1.58 t/ha) was predictably lower compared to the average yield of grain varieties (2.08 t/ha).

Comparison of pasture varieties

Key findings

- The average dry matter production for the first year pasture and regenerated pasture varieties were very similar, averaging 3.5t/ha in 2012

Why do the trial?

To compare the performance of first year pasture against regenerated pasture varieties.

How was it done?

Plot size	1.4m x 10m	**Fertiliser**	DAP + Zn 2% @ 50kg/ha
Seeding date	14th June 2011 for the regenerated section and the 30th May 2012 for the first year pasture mixes		

This trial was not a replicated trial and so the results do not include statistics. Dry matter cuts were taken from two places within each plot using a quadrat, on 10th September 2012.

Results

The first year pasture growth ranged from 2.17t/ha (Winter express blend) to 6.01t/ha (Wintaroo oats) while the regenerated legume variety production ranged from 2.95t/ha (Angel strand medic) to 3.99t/ha (Melilotus). In previous regenerated pasture trials Sulla Hedysarum has also produced very good dry matter production.

The average dry matter production for the first year pasture and regenerated pasture varieties was very similar, averaging 3.5t/ha in 2012.

Variety	Dry matter (t/ha)
Sown 30th May 2012	
Forage pea	3.04
Tetrone ryegrass	3.81
Wintaroo oats	6.01
Canola + vetch mix	4.25
Vetch + oats mix	3.36
Winter express - ryegrass, clover and medic blend	2.17
Sown 14th June 2011 - regenerated	
Melilotis	3.99
Angel strand medic	2.95
Frontier balansa clover	3.46
Antas sub clover	3.84
Lynx barrell medic	3.03

Table 1. Pasture dry matter production (t/ha) for first year or regenerated pasture varieties at Hart in 2012.

Durum agronomy – improving grass control in durum

Durum Weed Agronomy Project, funded by SAGIT in association with SA DGA

Compiled by Kenton Porker, and Rob Wheeler, SARDI

Key findings

- Fathom barley was more competitive than Hindmarsh barley, bread wheat and durum
- New durum variety Tjilkuri was no more competitive with ARG than older variety Tamaroi
- Increasing seeding rate reduced ARG head density and increased grain yields in all durum varieties; low seeding rates led to large numbers of ryegrass heads
- Narrower row spacing increased yield and reduced ARG head density in durum
- Early applied N improved early vigour, and reduced ARG head densities, but led to yield penalties due to induced moisture stress

Why do the trial?

There are now limited safe and effective herbicide options in durum. Older durum varieties have typically been less competitive with annual ryegrass (ARG) than bread wheat and barley. The trial at Hart in 2012 aimed to evaluate the relative the weed competitiveness of barley, bread wheat, and durum against annual ryegrass grown under different management practices including seeding rate, nutrition, variety, and row spacing.

How was it done?

Plot size: 1.4m x 10m

Seeding date: 30th May 2012

Fertiliser: DAP (18:20) + 2% Zn @ 70kg/ha

Post emergent nitrogen: 50kg N @ GS31

The trial was a randomised complete block design consisting of 3 replicates, and 15 treatment combinations designed to compete with annual ryegrass (Table 1). The trial was sprayed with a knockdown at sowing and pre spread with annual ryegrass to establish a consistent level of ryegrass across the site.

Table 1. Treatment combinations of crop type, variety, seeding rate, and additional management used to compete with ryegrass at Hart 2012.

Treatment	Crop	Variety	Seed rate (seeds/m^2)	Management change
1.	**Durum**	***Tamaroi***	***200***	***Standard (traditional practice)***
2.		***Tjilkuri***	***200***	***Standard (traditional practice)***
3.		Tamaroi	100	Lower seed rates
4.		Tjilkuri	100	Lower seed rates
5.		Tamaroi	300	Higher seed rates
6.		Tjilkuri	300	Higher seed rates
7.		Tamaroi	200	Extra N upfront (20kg N IBS)
8.		Tjilkuri	200	Extra N upfront (20kg N IBS)
9.		Tamaroi	200	Narrow row spacing (11.5cm)
10.		Tjilkuri	200	Narrow row spacing (11.5cm)
11.		Tjilkuri	200	High vigour seed (large seed size>2.8mm)
12.	Barley	Fathom	150	Standard
13.		Hindmarsh	150	Standard
14.	Bread Wheat	Scout	200	Standard
15.		UoA Competitive Line	200	Standard

Results

Annual Rye Grass

The treatments had no significant effect on the initial density of the pre spread annual ryegrass, across the trial site each plot had on average 72 ARG plants per square metre (Table 2).

Crop plant density

Crop plant densities differed between treatments. Fathom and Hindmarsh barley established similarly and close to their target density of 150 plants per square metre. Both bread wheats Scout and the UoA competitive line established at 176 plants per square metre. Plant densities in the standard treatment for durum were on average 170 plants per square metre (200 seeds per square metre), decreased by approximately 90 plants per square metre at the lower seeding rate, and increased by 50 plants per square metre at higher seeding rates (300 seeds per square metre). All other durum treatments established similarly to the standard treatment (Table 2).

Table 2. The effects of management combinations on plant density, ARG density, ARG head density (maturity), and crop grain yield.

	Treatment	Crop density (Plants/m^2)	ARG plant density (Plants/m^2)	ARG head density (Heads/m^2)	Grain yield (t/ha)
1	***200$_{sd/m^2}$ Tamaroi (standard)***	***175.7***	***67.0***	***85.2***	***0.70***
2	200 $_{sd/m^2}$ Tjilkuri	163.0	75.9	96.1	0.63
3	100 $_{sd/m^2}$ Tamaroi	89.7	78.2	160.0	0.62
4	100 $_{sd/m^2}$ Tjilkuri	87.9	70.7	130.1	0.66
5	300 $_{sd/m^2}$ Tamaroi	228.3	76.5	56.6	0.97
6	300 $_{sd/m^2}$ Tjilkuri	237.0	73.5	72.9	0.96
7	Tamaroi (narrow rows)	155.4	64.6	55.9	0.78
8	Tjilkuri (narrow rows)	150.4	67.3	84.5	0.97
9	Tamaroi (early N)	147.7	77.1	58.7	0.42
10	Tjilkuri (early N)	152.6	79.2	77.7	0.45
11	Large seeded Tjilkuri	183.5	69.4	75.0	1.26
12	Fathom	154.0	62.4	39.6	3.28
13	Hindmarsh	139.9	68.0	75.0	2.85
14	Scout	176.8	83.7	113.1	1.53
15	UoA competitive Line	176.1	66.7	50.5	1.20
	Site mean	161.2	72.01	82.06	1.16
	LSD 5%	21.1	NS	13.2	0.27

Competitiveness - Weed suppression and tolerance (grain yield)

Overall, barley was the most competitive, with Fathom barley more competitive than the erect, short variety Hindmarsh. Fathom barley resulted in the greatest suppression of ryegrass at 39.6 heads per square metre and yielded highest in the presence of ryegrass, at 3.28t/ha. Hindmarsh allowed almost twice the number of ARG heads observed in Fathom, and yielded 0.43t/ha less (Table 2).

The bread wheat Scout was less competitive than barley and the standard durum treatments, but yielded 0.75t/ha higher than durum. The Adelaide University competitive line yielded 22% lower than Scout but suppressed ryegrass comparably to Fathom barley, a significant improvement over Scout and the standard durum treatments (Table 2).

Compared to the standard treatment, additional management changes improved the competitive ability of both durum varieties. Reducing the seeding rate to 100 seeds per square metrre did not result in a yield penalty, however ryegrass head numbers increased by 50%. Increasing the seeding rate to 300 seeds per square metre improved yields in both durums by 0.3t/ha and reduced ryegrass head numbers by more than 35% (Table 1 & Figure 1).

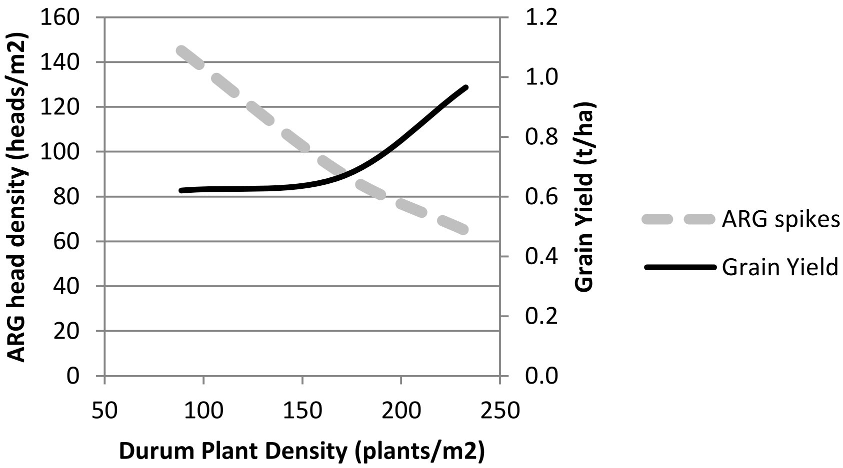

Figure 1: The fitted relationship between durum crop plant density (plants/m2) and ARG head density (heads/m2) and grain yield (t/ha) averaged across all durum varieties in selected treatments (1-6) at Hart 2012.

Sowing durum at 200 seeds per square metre into narrow row spacings resulted in greater suppression of ryegrass, achieved similar yields in Tamaroi, and improved yields in Tjilkuri. While early application of N led to reduced ryegrass heads, it was detrimental to yield due to a dry spring and severe crown rot. The larger seeded Tjilkuri improved yield by 0.59t/ha compared to the standard and achieved similar rye grass suppression to the higher seeding rate (Table 2).

Discussion

Moisture stress in spring along with severe crown rot infection across this trial site meant conditions were unfavourable for durum production; the relative yields of barley (3t/ha), bread wheat (1.5t/ha), and durum (0.9t/ha) reflect commercial experience with durum under these conditions.

The trial demonstrated durum to be less competitive than barley but no less than bread wheat. New durum variety Tjilkuri was no more or less competitive than older variety Tamaroi. Compared to the current practice of sowing durum at 200 seeds per square metre, increasing the seeding rate reduced ARG head density and increased grain yields. In addition, where practical narrowing row spacing and selecting larger seed may be viable options for growers to increase crop competition and improve yields in the presence of ryegrass.

Suggestions that lowering seeding rates may reduce yield losses from moisture stress were not supported; higher seeding rates were favoured even in the presence of ryegrass and in drought conditions. Consistent with other agronomic trials, early applied N improved early vigour and reduced ARG head densities, but predisposed durum to yield penalties from moisture stress.

Additional data from other sites and seasons will help to determine the optimal management combination for improved weed competiveness in durum.

Acknowledgements

Thanks to SAGIT for funding this research, SARDI Clare staff for trial management and the Hart Field-Site Group for provision of the land and extension of the work.

Barley Agronomy – nitrogen management in new barley varieties

Southern Barley Agronomy Project, funded by GRDC

Compiled by Kenton Porker, and Rob Wheeler, SARDI

Key findings

- Varieties responded similarly in yield and all quality parameters to applied N. Variety choice played a more important role on overall yield and quality than N management:
- Averaged across all N treatments Fathom yielded highest at 3.30t/ha, and late maturing variety Wimmera the lowest at 2.47t/ha
- No applied N, yielded 2.88t/ha, while 40kgN, applied at GS30, yielded 3.12 t/ha.
- Using the Greenseeker, improved agronomic N efficiency by more than 50% over all other N treatments

Why do the trial?

To examine the nitrogen responses of new malt and food barley varieties and determine appropriate N management strategies for maximum yield and quality.

How was it done?

Plot size: 1.4m x 10m

Seeding date: 1st June 2012

Fertiliser: DAP (18:20) + 2% Zn @ 70kg/ha

Deep Soil N Test: 65kg available N/ha

The trial was a randomised complete block design consisting of 3 replicates, 7 barley varieties and 6 nitrogen treatments:

6 nitrogen treatments (applied as urea), 100% = Urea @ 170kg/ha (80kgN/ha)

1. No applied N (nil)
2. 50% (40kg N) IBS (incorporated by sowing)
3. 100% (80kg N) IBS
4. 100 % (80kg N) GS30
5. 50% (40kg N) GS30
6. 12% GS30 (10kgN/ha) - Optical sensor (as determined by GreenSeeker)

Results

Early Growth responses

The initial deep soil N level was relatively low at 65kg N/ha which suggested there was likely to be an N deficit in targeting a 3.5 t/ha yield. The 50% and 100% N IBS treatment were used in each variety as an N-rich reference (measure of N response) treatment for the Green Seeker NDVI crop sensor. Relative to unfertilized treatments, both N rates (IBS) measured with a Greenseeker at GS22 produced no significant response to N but showed a 7% response at GS30. All varieties responded similarly at GS30 (table 1).

Table 3. Early season measurement of NDVI (GreenSeeker) and response to N at GS22, and GS30 in the unfertilised, and N rich plots applied with 40kgN, & 80kg N incorporated by sowing.

	NDVI GS22	% Response	NDVI GS30	% Response
No applied N (un-fertilized)	0.476	-	0.699	-
50% IBS (N – rich strip)	0.482	101	0.748	107
100% IBS (N – rich strip)	0.484	102	0.745	107

Optical sensor N rate calculations:

Based on an initial estimated 3.5t/ha yield potential, a 7% response from applied N at GS30 (N rich strip) assumes an extra 0.24t/ha can be achieved with applied N. Barley requires approx 1.61 kg N/tonne/% protein, therefore to grow an extra 0.24t/ha of barley at 10.5% protein will require 4kg N/ha. Since N applied at GS30 typically has an N use efficiency of 40%, the final N rate to achieve theoretical optimal yield is 10kgN/ha (22kg/ha Urea).

Grain Yield

Varieties responded similarly in yield to applied N. The no applied N treatment (2.88t/ha) and the 50% IBS treatment yielded similarly while all other N treatments yielded higher, ranging from a 5% yield response in the optical sensor method to 9% when 50% was applied at GS30. Similar yields were achieved in treatments 3 – 6, but with varying N application rates. Calculation of agronomic N use efficiency (kg grain per kg N applied), found that use of the Greenseeker for optimal N management produced 13kg grain per kg N compared to less than 6 kg/kgN for all other treatments (Table 2).

The effect of variety was greater than the effect of N on grain yield (Table 3) with Wimmera, a late maturing variety, yielding lowest at 2.47t/ha and Fathom, a new early to mid maturing variety, yielding 3.30t/ha. Between these varieties, Skipper, Hindmarsh, and IGB1101 all yielded similarly, and these led Commander and Buloke.

Table 4. The main effect of N treatments (100% = 80kg N/ha) on grain yield, agronomic N efficiency, and grain quality parameters average across all varieties at Hart, 2012.

N treatment		Grain yield (t/ha)	AE* (kg grain/kgN)	Retention (>2.5mm)	Screenings %<2.2mm	Test weight (kg/hL)	Protein (%)
1.	No applied N (nil)	2.88	-	33.3	12.1	71.2	11.7
2.	50% IBS	2.93	1.2	23.5	16.9	70.8	13.2
3.	100% IBS	3.07	2.4	22.2	21.9	70.1	13.3
5.	50% GS30	3.12	6.0	21.5	19.5	70.4	13.5
4.	100 % GS30	3.05	2.1	19.6	21.0	70.2	14.8
6.	12% GS30 (Sensor)	3.01	13.0	22.6	16.6	70.6	13.2
LSD (5%)		0.10		4.1	4.2	NS	1.2

*AE = Agronomic N efficiency = net increase in grain yield per kg N applied

Grain Quality

Varieties responded similarly to applied N for all grain quality parameters. Additional N reduced grain plumpness (retention) by an average 11% across all rates and timings and increased screening levels by 7% compared to the nil control (Table 2). Protein levels were also increased by N rate and later timing. Test weights were similar across all N treatments.

Varieties differed significantly for each quality parameter.(Table 3). Fathom produced the plumpest grain along with the lowest levels of screenings. Among the malt varieties, Commander had the best retention and lowest grain screening levels. Hindmarsh and IGB1101 were similar across all parameters. Fathom produced the lowest test weight at 69.8 kg/hL, and Wimmera the highest at 72.6 kg/hL, all other varieties were similar at 70.1 kg/hL. Varieties differed significantly in grain protein and differences did not correlate well with varietal yield differences ie yield dilution effect. For example Buloke and Commander were amongst the lower yielding varieties but also had the lowest proteins.

Table 5. The main effect of varieties (100% = 80kgN/ha) on grain yield, agronomic N efficiency, and grain quality parameters averaged across all N treatments at Hart, 2012.

Variety	Grain Yield (t/ha)	Retention (>2.5mm)	Screenings %<2.2mm	Testweight (kg/hL)	Protein (%)	Protein Yield (kg protein/ha)
Buloke	2.79	14.1	19.4	70.2	12.8	35.6
Commander	2.96	30.5	14.7	70.5	12.8	38.0
Fathom	3.30	42.1	10.1	69.8	13.0	42.8
Hindmarsh	3.15	17.5	23.3	70.1	13.2	41.6
IGB1101	3.19	17.1	22.5	70.2	13.0	41.1
Skipper	3.20	22.5	21.0	70.1	13.2	42.1
Wimmera	2.47	25.0	15.0	72.6	14.7	36.4
LSD (5%)	0.09	2.5	2.4	1.6	0.3	1.8

Summary

The results from this trial at Hart in 2012, indicate that current and emerging barley varieties respond similarly to N for grain yield or receival quality parameters. The dry finish to the season favoured earlier to mid maturing varieties. The predetermined N strategies of 40kg N and 80kg N led to an oversupply of N and decline in grain quality in all varieties. Besides over-application of N, high grain protein levels most likely arose from low rainfall after anthesis. This trial highlights the need for growers to address both N management and environmental uncertainties to produce profitable crops. While the effects of N rate and timing were significant, varietal choice played a greater role in overall yield and quality at this site in 2012. Growers should therefore consult the more extensive NVT data for information on varietal selection.

While no variety achieved malt specification in this trial, adopting a sensor-based or equivalent strategic approach may facilitate better fertiliser N decisions mid-season, since real time crop measurements taken during the season can indicate how much N has been delivered from the environment (i.e. mineralisation, background N). The results suggest that while soil testing was informative, applying a static value to N demand, based upon an early season soil test is not necessarily a reliable method. At Hart background levels of N indicated low levels of N and there was expected to be a large response to N, an estimate of 80kg N/ha was calculated to sustain a 3.5t/ha crop. However, the in season measurement of N response (using the Greenseeker sensor) showed no response to N at GS22, and only a small response at GS30, indicating the environment had delivered a large amount of N through mineralisation or that there is spatial variability in soil N at the site. Given the lack of in season N response, a much lower rate of 10kgN at GS30 was needed to achieve similar yields to the predetermined values of the 40kg and 80kg N strategies. Using a Greenseeker optical sensor for N management, improved the agronomic N use efficiency by more than 50% above all other N treatments.

Acknowledgements

Thanks to GRDC for funding this research, SARDI Clare staff for trial management and the Hart Field-Site Group for provision of the land and extension of the work.

Barley agronomy – deep sowing barley

Southern Barley Agronomy Project, funded by GRDC
Compiled by Kenton Porker, and Rob Wheeler, SARDI

Key findings

- Barley varieties differ in coleoptile length and their ability to emerge from depth
- Care at sowing should be taken when Triadimenol based dressings are used in conjunction with short coleoptile varieties such as Hindmarsh
- Choosing a long coleoptile variety, or combining higher seeding rates with a Carboxin based dressing may help counteract some of the plant establishment losses from deeper sowing

Why do the trial?

Agronomic combinations of barley variety, seed dressings, and seeding rate can influence plant emergence and early vigour when sown deep. A poor combination can weaken the agronomic system and leave the crop exposed to other factors such as root disease, poor weed competiveness and can ultimately lead to yield losses. The aim of this trial was to demonstrate best management practices that can give barley the best possible start from deeper sowing.

How was it done?

Plot size: 1.4m x 10m

Seeding date: 1st June 2012

Fertiliser: 70kg/ha DAP (18:20) + Zn 2%

The trial was a randomised complete block design consisting of three replicates, and six combination treatments of variety, sowing depth; seed rate and seed dressings (Table 1). Plant emergence counts, NDVI, and grain yield measurements were recorded from every plot.

Table 1. Treatment combinations of variety, sowing depth, seeding rate, and seed dressing for the demonstration trial at Hart, 2012.

Treatment	Variety	Sowing Depth	Seeding Rate (seeds/m^2)	Seed Dressing (Product active, & rate)
1.	Hindmarsh	Shallow (30mm)	150	Untreated
2.	Hindmarsh	Deep (75mm)	150	150g/L Triadimenol, 4g/L Triflumuron (100ml/100kg seed)
3.	Hindmarsh	Deep (75mm)	150	400g/L Carboxin, 3.2g/L Cypermethrin (250mL/100kg seed)
4.	Hindmarsh	Deep (75mm)	200	400g/L Carboxin, 3.2g/L Cypermethrin (250mL/100kg seed)
5.	Fleet	Shallow (30mm)	150	Untreated
6.	Fleet	Deep (75mm)	150	Untreated

Results

Plant emergence

Treatment combination one, of Hindmarsh sown shallow at 150 seeds per square metre with no seed dressing is considered the control treatment and established well at 148 plants per square metre (Figure 1). When Triademinol treated Hindmarsh was sown deeper at 150 seeds per square metre emergence was reduced by 25% and by 12% when treated with Carboxin. Increasing the seeding rate to 200 seeds per square metre along with Carboxin resulted in similar emergence to the control. Fleet established similar to the Hindmarsh shallow control at both sowing depths.

Early Vigour (NDVI 6 weeks after sowing)

Early vigour growth responses in Hindmarsh were representative of the plant emergence results. At deeper sowing Triadimenol treated Hindmarsh reduced vigour to the greatest extent and vigour was improved with Carboxin and a higher seeding rate. Compared to shallow sown Hindmarsh, Fleet had approximately 40% greater vigour sown shallow, and 25% when sown deep.

Grain Yield

Plant establishment and growth effects from deep sowing and seed dressing did not result in significant yields losses at this site in 2012. The grain yield of untreated Hindmarsh sown shallow was 2.71t/ha similar to all other treatment combinations of Fleet, Hindmarsh, sowing depth and seed dressings.

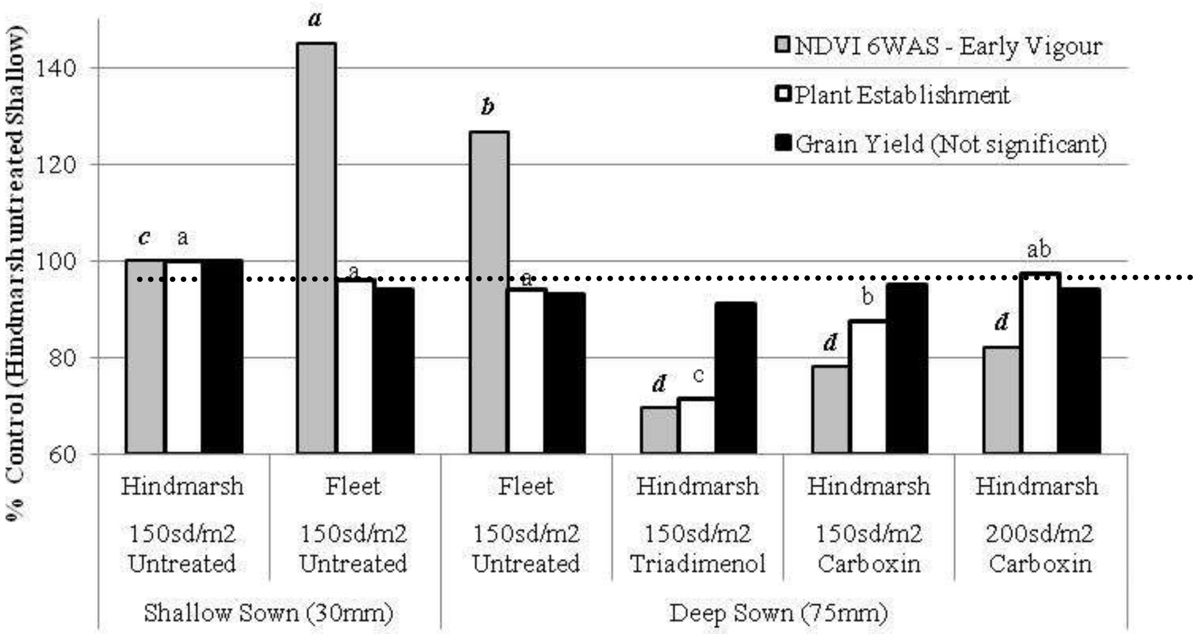

Figure 1: Plant establishment, NDVI (growth) taken 6 weeks after sowing, and grain yield expressed as a percentage of the Hindmarsh shallow sown control (148 plants per square metre, 2.7t/ha) from the combination treatments of variety, seed dressing, seeding rate, and sowing depth at Hart 2012 (treatments with the same letter are not significantly different).

Summary

Growers need to consider the combination of variety, sowing depth, seed dressing and seeding rate. Early vigour and emergence is almost always reduced by deeper sowing, however varieties differ in their tolerance to deeper sowing due to their seed size and coleoptile length. Hindmarsh is a shorter coleoptile variety, so care should be taken with seeding depth, whereas Fleet has the longest coleoptile (~85mm long) coupled with a large seed size.

Other barley varieties with long coleoptiles include Commander, Maritime and Fathom. Varieties with short to medium coleoptiles include Scope, Buloke, Oxford and Hindmarsh.

In addition Triadimenol seed dressings can shorten the coleoptile and further reduce establishment of shorter coleoptile varieties. A seed dressing containing the active ingredient Carboxin can lengthen the coleoptile by up to 10mm, thereby improving establishment from deeper sowing as demonstrated in this trial. The 2012 trial at Hart highlights that when sowing deep, growers should consider sowing a long coleoptile variety such as Fleet, or apply Carboxin (avoid Triadimenol) along with increased seeding rates if sowing shorter coleoptile varieties such as Hindmarsh. Yield differences between treatments were not established in this trial but any plant establishment and growth setbacks are likely to weaken the agronomic system, which may relate to yield losses depending on seasonal conditions

Acknowledgements:

Thanks to GRDC for funding this research, SARDI Clare staff for trial management and the Hart Field-Site Group for provision of the land and extension of the work.

Photo: Hindmarsh barley sown at 80mm depth (left hand side) or 25mm depth (right hand side) at Hart 2012.

Canola agronomy – retaining hybrid seed

Key findings

- The early growth of commercial and farmer retained canola seed appeared to be similar
- Jockey fungicide seed treatment improved the yield of farmer retained seed for the triazine and imidazolinone tolerant varieties
- The conventional variety Hyola 50 was consistently higher yielding when grown from commercial seed

Why do the trial?

Many canola varieties are now hybrid, meaning that they rely on a specific gene combination from two selected parents. Hybrid varieties are recommended to be grown from commercially produced seed to ensure maximum production. The seed is expensive (about $25/kg) compared to open pollinated or farmer retained seed and so can significantly increase the cost of growing canola. Previous trials with open pollinated varieties have shown that they generally do not lose any grain yield or varietal characteristics when grown from farmer retained seed (F1 – first year of harvested seed). However, these were not hybrid varieties.

This trial was conducted to compare the performance of commercial hybrid seed against farmer retained (F1) seed using conventional, triazine and imidazalinone tolerant varieties.

How was it done?

Plot size	1.4m x 10m	**Fertiliser**	DAP (18:20) 2% Zn @ 100kg/ha
Seeding date	30th May 2012		UAN @ 80L/ha, 24th July

Trial was a randomised complete block design consisting of 3 replicates and 16 canola treatments.

Varieties –Hyola 50 conventional, Tumby HT Triazine Tolerant and 45Y82 Clearfield

Seed sources –

- Commercial - certified commercial seed from bags
- Retained – collected from farmer seed sources and graded

All the canola plots were sown with the aim of 50 plants per square metre, with rates adjusted for seed size, germination and an estimate of likely emergence.

Seed treatment – either nil Jockey or Jockey on the seed at 20L/tonne.

The plots were windrowed on 25th October.

All plots were assessed for early blackleg infection, early vigour, plant number, flowering date, grain yield and oil content.

Results

The growth of the canola treatments throughout the growing season appeared to be similar. Early differences in plant number, vigour and blackleg leaf lesion assessments showed no difference between the treatments.

On the 11th September the Hyola 50 and Tumby HT were at 50 to 60% flowering, while the 45Y82 was at 80%. There was no difference between the seed source or seed fungicide treatments. At this stage in the season the Hyola 50 plots from commercial seed looked to have better growth and crop health compared to the farmer retained plots. Little difference could be picked in the 45Y82 or Tumby HT plots.

Considerable variation existed across this trial area due to snails and mice at emergence and wind and galah damage to the windrows later on. So, the resultant grain yield results should be viewed with caution. The average canola yield for the site was 700kg/ha with the commercial Hyola 50 nearly yielding 900kg/ha.

With no Jockey fungicide applied to the seed, Hyola 50 and 45Y82 commercial seed lines were significantly higher yielding by 270 and 180kg/ha respectively, compared to the farmer retained seed. The Tumby HT was not significantly different.

However, when the Jockey fungicide seed treatment was used there was no significant difference between the commercial and farmer retained seed for Tumby HT and 45Y82. The Hyola 50 was still significantly higher yielding with the seed fungicide, by 140kg/ha.

There was no difference between any of the treatments for oil content.

Although this was a low yielding trial and was subject to much site variability, these results have also been produced at other lower and higher rainfall sites throughout the state in 2012.

Table 1. The grain yield of 3 canola varieties, from commercial or retained seed and with or without a Jockey seed treatment, at Hart 2012. (LSD for the 3-way interaction is 0.09. All interactions were significant)

Variety	Commercial seed		Retained seed (F1)	
	No Jockey	Jockey	No Jockey	Jockey
Hyola 50	0.88	0.87	0.61	0.73
Tumby	0.49	0.53	0.55	0.50
45Y82	0.88	0.67	0.70	0.70

Table 2. The oil content of 3 canola varieties, from commercial or retained seed and with or without a Jockey seed treatment, at Hart 2012. (LSD for all interactions was ns)

Variety	Commercial seed		Retained seed (F1)	
	No Jockey	Jockey	No Jockey	Jockey
Hyola 50	42.0	42.1	42.4	42.5
Tumby	41.9	42.0	42.0	42.0
45Y82	42.8	42.5	42.4	42.6

JOCKEY **NO JOCKEY**

Tumby commercial 11th Sept

JOCKEY **NO JOCKEY**

Tumby retained 11th Sept

JOCKEY **NO JOCKEY**

45Y82 Comm 11th Sept

JOCKEY **NO JOCKEY**

45Y82 Retained 11th Sept

JOCKEY **NO JOCKEY**

Hyola 50 Comm 11th Sept

*(*Mouse damage excluded from yield results)*

JOCKEY **NO JOCKEY**

Hyola 50 Retained 11th Sept

Phosphorus rate trial and alternative fertilisers

Key findings

- A response to fertiliser after 5 years of no phosphorus applications
- Alternative phosphorus sources such as biosolids, chicken litter or biochar, produced significantly lower yields compared to phosphorus fertiliser
- Biosolids and chicken litter significantly increased leaf and grain zinc concentrations

Why do the trial?

To investigate the impact of conventional phosphorus fertilisers and alternative sources of phosphorus on the grain yield and quality of wheat.

How was it done?

Plot size	1.4m x 10m	**Fertiliser**	Urea @ 50kg/ha at sowing
			Phosphorus applied as per treatment
Seeding date	12th June 2012	**Variety**	Hindmarsh barley @ 80kg/ha

<u>Trial 1. Phosphorus rate:</u> randomised complete block design with 3 replicates and 4 treatments.

Treatments were re-sown over the same treatments from 2007, 2008, 2009, 2010 and 2011.

<u>Trial 2. Biosolids and chicken litter:</u> randomised complete block design with 3 replicates and 8 treatments.

A single application of biosolids and chicken litter were broadcast prior to sowing in 2008.

No further fertiliser has been added to these treatments. The biosolids + 65kg/ha single super, and chicken litter + 65kg/ha single super treatments had a repeated application of 65kg/ha single super in 2009, 2010, 2011 and 2012. In season foliar phosphorus treatments were added in 2010 and 2011.

Treatments were re-sown over the same treatments areas each year since 2008.

<u>Trial 3. Biochar, phosphorus solubiliser and foliar phosphorus:</u> randomised complete block design with 3 replicates and 12 treatments.

A seed and foliar combination phosphorus treatment plus either 5 or 10kg of granular phosphorus were added treatments for 2011. All other previously applied treatments of biochar or phosphorus solubiliser were repeated in 2011.

Treatments were sown into standing barley stubble from the 2010 trial.

Single superphosphate was used as the standard phosphorus treatment.

The initial Colwell soil phosphorus (March 2007) was 40mg/kg (0 – 10 cm).

The phosphorus buffering index (PBI) was 102.

Plots were assessed each year for grain yield, protein, test weight and screenings (2mm screen).

Assessments were also conducted in 2011 for dry matter yield, leaf and grain nutrient concentrations.

Samples of the biosolids and chicken litter used in 2008 were analysed for nutrient concentration (Table 1).

Table 1. Fertiliser nutrient concentrations (kg/t) of biosolids and chicken litter applied in 2008.

Nutrient	Single superphosphate	DAP	Biosolids	Chicken litter
Nitrogen	0	180	15	43
Phosphorus	90	200	10	8
Potassium	0	0	8	2
Sulphur	110	15	8	6
Zinc	0	0	1	1

Results

In the long term phosphorus experiment (Trial 1) the grain yield ranged between 2.3t/ha (nil phosphorus) to 3.0t/ha (10 or 15kg P/ha). It has taken 6 years of continuous cropping for this difference to develop. Applying 5kg P/ha increased grain yield above the nil, but the 10 or 15kg P/ha rates produced significantly higher yields. This is statistically significant at the 95% level.

It took 5 years of receiving no phosphorus to gain a significant response to the addition of any phosphorus. But after a further year there is a response to phosphorus rate, i.e more than 5kgP/ha. It should be noted that from very early on in the history of the trial, crop dry matter would generally increase with phosphorus fertiliser rate. However, in most cases this did not result in extra grain yield.

In 2012 it meant the highest phosphorus rate of 15kg P/ha had slightly greater screenings.

Protein levels whilst not significantly different, did decline with increases in grain yield in this trial.

Table 2. Trial 1. Grain yield (t/ha), protein (%), test weight (kg/hL), retention (%) and screenings (%) at Hart in 2012.

Treatment	Grain yield (t/ha)	Protein (%)	Test weight (kg/hL)	Screenings (%)
Nil	2.3	12.7	69.9	4.9
5 kg/ha P	2.6	12.6	70.0	5.0
10 kg/ha P	3.0	12.6	70.4	4.5
15 kg/ha P	3.0	12.3	69.9	6.2
LSD (0.05)	0.32	ns	ns	1.0

In trial 2 the addition of 6 or 10kg P/ha for the past 5 seasons also significantly increased grain yield compared with no phosphorus. The addition of Crystal Green or a foliar treatment were also higher than the nil treatment. The biosolid or chicken litter treatments alone were lower yielding.

There were no significant differences in grain protein, test weight or screenings which are attributable to treatments.

Table 3. Trial 2. Grain yield (t/ha), protein (%), test weight (kg/hL), and screenings (%) at Hart in 2012.

Treatment	(t/ha)	Protein (%)	(kg/hL)	(%)
Nil	2.4	12.9	69.9	3.5
5t/ha Biosolids	2.5	12.8	69.7	3.3
5t/ha Biosolids + 6kg/ha P	3.0	12.9	70.2	4.5
3t/ha Chicken litter	2.6	12.6	69.8	2.8
3t/ha Chicken litter + 6kg/ha P	2.9	13.0	70.4	3.4
10kg/ha	2.8	12.9	69.8	5.3
Crystal Green	2.8	12.9	70.3	3.9
Foliar 2	2.8	12.6	70.5	2.9
LSD (0.05)	0.35	ns	ns	ns

In trial 3 grain yields ranged between 2.0t/ha and 2.6t/ha, with no significant difference in grain quality between the treatments. All treatments receiving 10kg P/ha for the past 4 seasons were significantly higher yielding (2.7t/ha) compared to no phosphorus fertiliser (2.1t/ha). The addition of biochar or foliar phosphorus applications did not increase grain yield or quality.

Table 4. Trial 3. Grain yield (t/ha), protein (%), test weight (kg/hL), and screenings (%) at Hart in 2012.

Treatment	(t/ha)	Protein (%)	(kg/hL)	(%)
Nil	2.1	12.7	69.6	4.4
500kg/ha Biochar	2.0	12.9	69.1	4.1
5kg/ha P	2.4	13.0	69.1	5.9
10kg/ha P	2.7	12.7	68.7	6.2
500kg/ha Biochar + 5kg/ha P	2.2	13.0	69.0	5.7
500kg/ha Biochar + 10kg/ha P	2.6	12.7	69.5	5.1
500kg/ha Biochar + Liquid P	2.4	13.0	68.3	5.3
5kg/ha P + Dow	2.1	12.9	69.5	4.2
10kg/ha P + Dow	2.2	12.9	69.9	4.1
5kg/ha P + Poly P	2.3	12.7	69.8	3.4
10kg/ha P + Poly P	2.6	12.7	69.5	4.9
LSD (0.05)	0.24	ns	ns	ns

Soil phosphorus measurements in Autumn 2012 showed that 10 or 15kgP/ha applied since 2007 had maintained soil phosphorus levels. Soil phosphorus level has significantly declined with the addition of 0 or kgP/ha/yr. A single application of biosolids or chicken litter in 2008 with no further addition of phosphorus fertiliser has produced soil DGT levels between the 5 and 10kgP/ha rates.

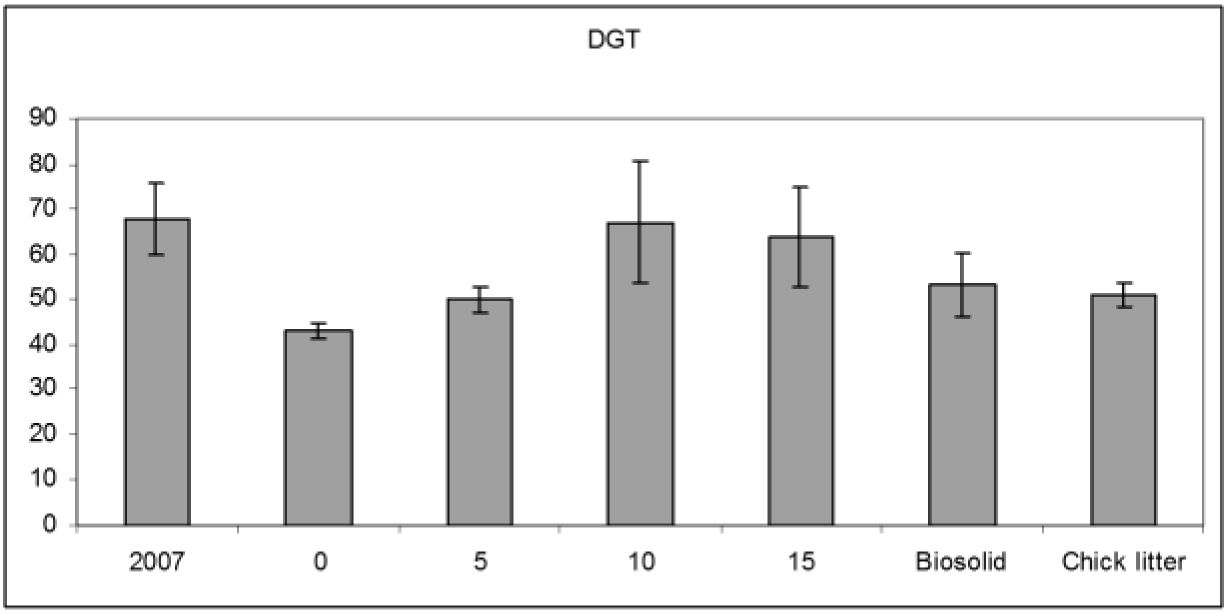

Figure 1: Soil DGT phosphorus (0-10cm) levels measured in the Autumn of 2007 and then in Autumn 2012 for phosphorus rates between 0 and 15kg/ha/yr and biosolids or chicken litter at the Hart field site.

Hart's 'Getting The Crop In' seminar 2012

Lentil and field pea agronomy 2012

Stuart Sherriff, Mick Lines & Larn McMurray, SARDI.

Key findings

- Delaying sowing from 22nd May until 16th June led to an average 0.39t/ha yield reduction in 2012
- Field peas had higher grain yields than lentils at both sowing times and both sites
- At the lower yielding western site earlier maturing lentil varieties outperformed later maturing varieties Nipper and Nugget
- All field peas and field pea blends produced similar grain yields at each site and time of sowing

Why do the trials?

Interest in growing lentils has increased in recent years due to high grain prices and the availability of improved varieties leading to an increase in area sown in the more marginal pulse growing areas. Field peas have traditionally been considered to be the most reliable break crop in these areas despite lower grain prices. Recently released lentil varieties with improved disease characteristics, higher grain yield and earlier maturity timings may now provide a viable alternative to field peas in these areas. Trials to compare new lentil varieties with older standards and current field pea options were set up on two contrasting soil types at Hart from 2010 - 2012. The two trial sites comprised one on a less suitable soil type for pulse production (West Site) with higher soil EC and the other was placed on a deeper soil more suited to pulse production (East Site), allowing a comparison of varieties under less favourable conditions.

Two "Kaspa type" seed mixtures (blends), broadening the flowering and maturity range when compared with the standard varieties were also included in the 2012 experiments.

How was it done?

Plot size	1.5m x 10m	**Fertiliser rate**	MAP 2% Zn @ 90kg/ha
Sowing date	TOS 1: 22nd May 2012	**Inoculant**	-
	TOS 2: 19th June 2012	**Row Spacing**	22.5 cm (9")

Varieties (plant density)

Lentils; @ 120 plants per square metre;

PBA Blitz, PBA Flash , PBA Jumbo, Nipper, Nugget and CIPAL0902

Field Peas @ 55 plants per square metre;

Varieties: PBA Gunyah, PBA Twilight, PBA Oura and Kaspa

Blends: Kaspa mix (50% Kaspa, 25% PBA Gunyah and 25% PBA Twilight) and mixture (33% Kaspa, 33% PBA Gunyah and 33% PBA Twilight)

Sites

West (at top of Hart site hill), shallow hard setting, higher salinity

East (at bottom of Hart site hill), deeper well-structured and more friable

Trial design Due to the difficulties associated with growing peas and lentils in the same trial they have been separated into blocks within each site.

Each site and crop type were analysed separately as a split plot design with 3 reps, blocked by sowing date.

Comparisons between sites and crop types are not statistically analysed.

Fungicides All field pea plots were treated with 2.2kg/ha mancozeb at 9 node.

All lentil plots were treated with carbendazim at 500mL/ha at canopy closure.

Results

The average grain yield for the eastern site was 1.27t/h compared with 1.1t/ha at the western site. Lentils produced an average grain yield of 0.94t/ha across both sites and field peas produced 1.43t/ha.

There was no time of sowing by variety interaction at either site or for either crop. All varieties and both sites responded the same way to time of sowing, where by, as sowing was delayed grain yields declined (Table 1). At the eastern site a yield decrease of 0.54t/ha for both crops occurred and at the western site a smaller decrease of 0.32t/ha occurred for the lentils and 0.22t/ha for the field peas.

Table 1. Average lentil and field pea grain yield (t/ha) for time of sowing and site at Hart in 2012.

TOS	**Lentils**		**Field peas**	
	East site	**West site**	**East site**	**West site**
TOS 1 May-22	1.26	1.04	1.82	1.43
TOS 2 Jun-19	0.73	0.72	1.28	1.21
Site LSD 0.05	0.08	0.13	0.12	0.17

Across both times of sowing all lentils performed similarly at the eastern site, producing an average 0.99t/ha (Table 2). At the western site, with less suitable soil, there were significant differences where Nipper produced the lowest grain yield (0.6 t/ha) and the earlier maturing variety, PBA Blitz produced 1.07t/ha. The three recently released lentils, PBA Jumbo, PBA Flash and PBA Blitz and the breeding line CIPAL 902 all produced similar grain yield at this site, where as the older lentils, Nipper and Nugget were lower yielding.

Table 2. Lentil and field pea variety grain yields averaged for time of sowing at the east and west site.

Lentils			Field peas		
Variety	Grain yield (t/ha)		Variety	Grain yield (t/ha)	
	East	West		East	West
Nipper	0.89	0.63	**Kaspa**	1.50	1.24
Nugget	0.99	0.72	**Kaspa Mix**	1.52	1.37
PBA Jumbo	1.00	0.91	**Mixture**	1.48	1.30
CIPAL902	1.07	0.97	**PBA Gunyah**	1.59	1.31
PBA Flash	1.02	0.98	**PBA Oura**	1.61	1.26
PBA Blitz	0.99	1.07	**PBA Twilight**	1.60	1.43
LSD 0.05	ns	0.22	**LSD 0.05**	ns	ns

All field pea varieties produced similar grain yields ranging from 1.48t/ha (Mixture) to 1.61t/ha (PBA Oura) at the eastern site and 1.24t/ha (Kaspa) to 1.43t/ha (PBA Twilight) at the less suited western site (Table 2). The Kaspa mixtures all produced similar yields showing that were no advantages to mixing these similar seed types in 2012.

Result Summary 2010 – 2012

Over the last three years there have been different crop type and variety responses to the different seasonal conditions that have occurred. Table 3 shows a summary of the significant seasonal conditions that occurred and the variety responses associated with that season. Generally in higher yielding years lentils produced high grain yields, greater or equal to field peas. In the tighter finishing seasons field peas produced higher yield than the lentils. The newer lentil varieties performed as well or better than the older varieties in most cases.

Table 3. Significant seasonal events, field pea versus lentil comparisons and old lentils versus newer lentil variety comparisons for the three years of testing at Hart in 2010, 2011 and 2012.

Year	Significant seasonal events	Field peas vs. Lentils	Older Lentils vs. New Lentils
2010	High rainfall, with cool grain filling period, high yielding season	Lentils produced grain yields 17% higher than field peas	New lentil varieties produced slightly higher grain yields at the better site than the older varieties
2011	Late season rainfall favoured late maturing varieties and led to a complex variety by time of sowing interaction	Field peas produced higher yields than the lentils at the better site and similar yields at the poorer site	Early maturing PBA Blitz finished before late rain when sown early leading to lower yields. Nipper produced low yields at the poorer site when sown late. Other new lentils produced similar yields to the older varieties.
2012	Low rainfall but mild finishing temperatures with no clear finishing event (heat event) to the season	Peas produced higher yields than lentils	New lentils produced greater grain yields than the older varieties at the less favourable site.

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Discussion

Overall lentil and pea grain yields averaged 1.18t/ha across all sites and treatments in 2012. There was no significant foliar disease and the major yield limiting factor was the lack of late season rainfall, only 25mm in September and October. Although only small the slightly higher grain yield at the eastern site (1.27t/ha) compared to the western site (1.10t/ha) highlights the importance of paddock and crop selection to maximise pulse yields in these more marginal areas. A similar result was found in 2011 where there was a 0.4t/ha yield decrease from the eastern to the western site, 2.23t/ha to 1.76t/ha respectively.

Time of sowing was the largest influencing factor determining grain yield at Hart in 2012 as there was a clear advantage observed from sowing early. All varieties from both crops were significantly penalised as sowing was delayed until the 19th of June. The yield reduction from TOS 1 to TOS 2 was an average of 0.41t/ha across both crops and sites, with the greatest reduction occurring at the high yielding eastern site (0.54t/ha). This average yield reduction equates to 14.5kg/ha/day of delayed sowing from 22nd May. A similar result was also observed at Hart in 2011 in the lentil agronomy trials.

In TOS 2 in 2011 at both sites, variety maturity timing had a strong influence on grain yield where later maturing varieties were lower yielding (PBA Blitz also produced low yields due to maturing before the onset of late season rains). In 2012 at the lower yielding western site, the newer and earlier maturing lines produced higher grain yields than the later maturing variety, Nipper. This repeatable response in lower yielding situations shows that the newer lentil varieties have the ability to maintain grain yield in both higher and lower yielding conditions.

It was the high lentil prices that occurred around 2009 that sparked the interest in growing lentils in these areas. If grain price is considered then lentils may have the advantage, providing grain quality can be achieved. The newer lentil varieties that are available are more determinate in flowering and generally earlier in their maturity and therefore finish more quickly. This can lead to improved quality due to more consistent seed size and even seed maturity improving harvest timing and efficiency. Harvestability is also improved with more erect plant types such as PBA Flash and PBA Blitz, however this can increase the risk of pod drop, as was seen in some crops in 2012.

The pea blend trials have been implemented to assess the possibilities of mixing the “Kaspa type” pea varieties (Kaspa, PBA Gunyah and PBA Twilight). The pea varieties and blends at both sites all produced similar yields despite maturity timing and duration differences. This result was also observed in other field pea blend trials around the mid north including Snowtown, Balaklava and Willamulka on the Yorke Peninsula. At the high yielding pea blend trial at Turretfield, Kaspa was found to produce higher yields than other blends and varieties; this result is consistent with long term evaluation of these varieties and shows that in higher yielding situations Kaspa is still the preferred variety.

Over the last three years trials have shown that lentils can be successfully grown in these environments, however caution should be taken on paddocks with variable soil types as poorer areas will struggle to reliably produce grain yields particularly if sowing is delayed or the season is unfavourable. The new lentil varieties have performed equal or better than the older varieties over the last three years of testing and provide more reliable options for lentil growers in these areas. Generally field peas maintained their superiority in these environments but were lower yielding in the best season of 2010. Further genetic improvements are still required in lentil to match field pea yield performance in less favourable years, however large grain price differentials between the two will continue to make them a viable alternative providing quality parameters are achieved. In 2012 field pea varieties all performed equally and the field pea blends showed that there was no advantage or disadvantage from mixing varieties in medium to low rainfall areas.

Plant growth regulators in wheat

This trial was funded by the GRDC and conducted in collaboration with Victor Sadras, SARDI and Glenn McDonald from the University of Adelaide.

Key findings

- Plant growth regulators had no significant impact on wheat grain yield in 2012, at four different sites
- Plant growth regulators can reduce grain yield and quality with incorrect application timing, especially to crops under stress i.e dry, nutrient deficient, frost, waterlogging

Why do the trial?

Plant growth regulators (PGR's) are routine inputs for cereal crops in Europe and New Zealand, where their main role is in the prevention of crop lodging. In southern Australia much work has previously been conducted on PGR's, with the results generally being inconsistent. Even where crop height is significantly reduced, grain yield and crop water use efficiency does not always increase.

To measure the effect of plant growth regulants and their interaction with nitrogen on wheat grain yield and quality, in the absence of lodging.

The trials were conducted on WUE sites established in 2008 on different soil types and rainfall zones in selected grower paddocks. The sites established are:

- Hart, 400mm annual rainfall, sandy clay loam
- Condowie, 350mm, sandy loam
- Spalding, 450mm, red brown earth
- Saddleworth, 500mm, black cracking clay

How was it done?

Plot size	8m x 10m			
Seeding date	Hart 30th May 2012	**Fertiliser**	Hart	DAP@80kg/ha+2% Zn
	Condowie 21st May		Condowie	DAP@65kg/ha+2% Zn
	Spalding 17th May		Spalding	DAP@80kg/ha+2% Zn
	Saddleworth 18th May		Saddleworth	DAP@100kg/ha+2% Zn

Post emergent nitrogen:

The Hart site received 40kg N/ha on the 24th July and the other sites on the 13th August.

The PGR treatments received an extra 46kg N/ha on the 3rd of September.

The PGR treatment (1L/ha Cycocel + 200ml/ha Moddus Evo) was applied on the 13th August. The crops ranged between later tillering to early stem elongation (GS31).

Each trial was a randomised complete block design with 3 replicates using Gladius wheat at each site. The trials were sown with 50mm chisel points and press wheels on 225mm (9") row spacing.

All cereal grain plots were assessed for grain yield, protein, and wheat screenings with a 2.0mm screen.

Results

All PGR treatments significantly reduced stem internodes and therefore overall crop height by at least 10cm. This was very visual and the plots could be easily spotted.

The PGR application did not increase grain yield at any of the sites. At Spalding, the PGR significantly reduced grain yield by 0.20t/ha. The addition of nitrogen with the PGR did not produce any yield increases (Table 1).

The application of nitrogen in early September significantly increased grain protein at each site and did not affect screenings. The PGR application had little effect on protein or screenings. The exception being Spalding, where the PGR increased screening levels to 7.2%.

Table 1. The interaction of PGR's and nitrogen on the grain yield and quality of gladius wheat at Hart, Condowie, Saddleworth and Spalding in 2012.

Site	Treatment		Grain yield	Protein	Screenings
	PGR	Nitrogen	(t/ha)	(%)	(%)
Hart	No	0	2.01	11.0	2.2
	No	46	1.73	11.5	2.5
	Yes	0	1.89	10.4	2.2
	Yes	46	1.70	10.8	2.1
LSD (0.05) Nitrogen, PGR, Nitrogen * PGR			ns, ns, ns	0.36, 0.36, ns	ns, ns, ns
Saddleworth	No	0	4.46	5.9	2.5
	No	46	4.89	6.4	2.5
	Yes	0	4.75	6.0	2.7
	Yes	46	4.88	7.1	2.5
LSD (0.05)			ns, ns, ns	0.73, ns, ns	ns, ns, ns
Condowie	No	0	2.50	10.1	2.7
	No	46	2.62	10.4	2.8
	Yes	0	2.47	10.2	2.3
	Yes	46	2.45	10.7	2.2
LSD (0.05)			ns, ns, ns	0.28, ns, ns	ns, ns, ns
Spalding	No	0	2.85	10.9	5.1
	No	46	3.16	12.0	4.8
	Yes	0	2.65	11.5	7.2
	Yes	46	2.83	13.1	7.1
LSD (0.05)			0.17, 0.17, ns	0.47, 0.47, ns	ns, 0.54, ns

Acknowledgements

The Hart Field-Site Group wish to thank Brian Kirchner and Simon Goldsmith, Andrew and Rowan Cootes, Michael and David Miller, David Hentschke and Matt Ashby for the use of their paddocks and cooperation with this trial work.

Photos: The effect of a PGR treatment on crop height at Hart on the right and Saddleworth on the left.

Controlling wild oats

This trial is funded by the GRDC and is part of a collaborative project. It was conducted with Sam Kleemann, University of Adelaide and Peter Boutsalis, Plant Science Consulting.

Key findings

- Two years of full wild oat control did not exhaust the seedbank to a manageable level
- A selective post emergent herbicide or an early hay cut were the most effective strategies for reducing the wild oat seedbank

Why do the trial?

The density of wild oats *(Avena fatua)* is increasing in the Mid North. This is due to an increase in cereal cropping intensity and the increase in herbicide resistance to Group A fop and dim herbicides. Also, traditional measures implemented for the control of annual ryegrass such as pre-emergent herbicides, export oaten hay, chaff carts and crop topping are generally less effective against wild oats.

This trial aimed to evaluate the effect of long term management strategies on the wild oat seedbank and measure the efficacy of various control techniques. Specifically, the trial will demonstrate the value of single year and back-to-back years of seed set control, pre-emergent and post emergent herbicides, hay cutting and chaff cart for driving down the wild oat seed bank.

Herbicide resistance and wild oats – Peter Boutsalis, Plant Science Consulting

Herbicide resistance in wild oats occurs in all cereal growing regions. A random survey conducted in 1995 detected 5% of wild oat samples collected from NE Victoria as resistant to Hoegrass. In 2006, the number had increased to only 8% in a similar survey. In the Mid-North 35% of paddocks contain wild oat and of these 9% were resistant to Topik or Wildcat (Table 1).

Often wild oats can be resistant to certain Group A Fop herbicides and not others eg. resistant to Wildcat but not Verdict. In addition some fop-resistant wild oats are cross-resistant to Mataven, although Mataven may have never been used previously. Dim/Den herbicides can be effective on fop-resistant wild oats although this can be variable. About 50% of wild oats resistant to Topik or Wildcat are also resistant to Axial and / or Mataven.

A small number of Group B resistant wild oats have been reported. No resistance to IMI (Group B) chemistry or to trifluralin (Group D) or triallate (Group J) has been detected.

Table 1. Occurrence of herbicide resistance across South Australia and Victoria as detected by ***random*** *sampling. Data is* ***% of paddocks*** *with herbicide resistant wild oats. Resistance is defined as samples where ≥ 20% survival was detected in a pot test. A dash indicates no test with that herbicide*.

Herbicide	Victoria Western (2005)	Victoria Northern (2006)	SA Mid North (2008)	SA Eyre Peninsula (2009)
Fields with wild oats	31%	81%	35%	36%
Hoegrass	17	8	>9	>2
Topik/Wildcat	-	-	9	2
Verdict	-	-	4	2
Axial/ Achieve	-	2	6	2
Mataven	-	-	14	0
Atlantis	-	-	0	0

How was it done?

This trial was established in a grower paddock, north of Clare (White Hut) on an existing patch of wild oats in 2009. The majority of wild oat seed was within 2cm of the soil depth, some being on the soil surface, and the oats were 100% susceptible to group A post emergent selective herbicides. The trial was established as a randomised complete block design with 3 replicates.

The trial was sown to Catalina wheat (2009), Commander barley (2010) and TT canola (2011), and wild oat control treatments were applied to the same plots each year. The herbicides treatments were applied IBS (incorporated by sowing) prior to sowing with a commercial seeder (i.e. knife-point & press wheels).

Treatments:

1) nil
2) Trifluralin 1.5L/ha (incorporated by sowing - IBS)
3) Trifluralin 1.5L/ha and Avadex Xtra 2.0L/ha (IBS)
4) Trifluralin 1.5L/ha and Avadex Xtra 2.0L/ha (IBS) + Axial 200ml/ha (GS39)
5) Trifluralin 1.5L/ha (IBS) + early hay cut
6) Trifluralin 1.5L/ha (IBS) + chaff cart
7) Trifluralin 1.5L/ha (IBS – 2009 and 2010) + Axial 200ml/ha (GS39 2009 only)
8) Trifluralin 1.5L/ha (IBS – 2009 and 2010) + Axial 200ml/ha (GS39 2009 and 2010)
9) Trifluralin 1.5L/ha (IBS – 2009 and 2010) + Axial 200ml/ha (GS39 2009, 2010 and 2011)

In 2011 complete desiccation was applied to all the treatments excluding 5, 8 and 9, as the wild oat density was excessive.

The initial seedbank at the site in 2009 was 400 wild oat seeds per square metre to 10cm of soil depth and 150 plants per square metre emerged in the nil treatments after sowing.

The hay cut was performed at the beginning of the hay cutting season, and the chaff cart was simulated by removing wild oat heads at the beginning of harvest as determined by district practice in both cases.

Results

Clear differences in the wild oat seedbank have been shown for the different management strategies applied in 2009, 2010 and 2011 (Figure 1). With no control the wild oat seed density increased from 400 seeds per square metre in 2009 to 8092 seeds per square metre in 2011, a 20 fold increase. Similar increases in the wild oat seedbank were measured for trifluralin applied alone or when mixed with Avadex Xtra, which provided limited wild oat control.

When Axial was included as a late selective post emergent application the seedbank declined to less than 64% of the original 2009 level (400 seeds per square metre). This treatment may not be as effective on wild oats with resistance to group A herbicides.

One year of full wild oat control reduced the wild oat seedbank to 8 seeds per square metre in 2010. While the trial average was only 8 seeds per square metre, 19 wild oat plants per square metre was counted 4 weeks after sowing and without control meant the seedbank increased significantly in 2011. Two years of full control has reduced the seedbank down to about 500 seeds per square metre, which is unexplainably higher than the initial seedbank of 400 seeds per square metre.

Of the cultural control practices the early hay cut was an effective strategy for reducing the wild oat seedbank (30 seeds per square metre after 3 years) (Figure 1 & 2). The cut was done early and did not include raking or super conditioning, which might increase wild oat seed shed. The simulated chaff cart treatment was applied early in the harvesting window, but had limited success as many of the wild oats had already dropped seed by the time of harvest.

Three years of full control was needed to reduce the seedbank to 30 seeds per square metre (Figure 2). The early hay cut was also able to achieve this level of control. Only two years of full seed set control was not enough to prevent the seedbank increasing to 611 seeds per square metre. The variability of these results highlights the variable nature of wild oats and also the possibility that 3 years of full control may still not be enough.

In general, the success of wild oat control techniques might also be influenced by the competitiveness of the crop, soil type, growing season rainfall and finish to the season. So, in seasons with a mild finish or in later districts it is likely that more wild oat seed will be set.

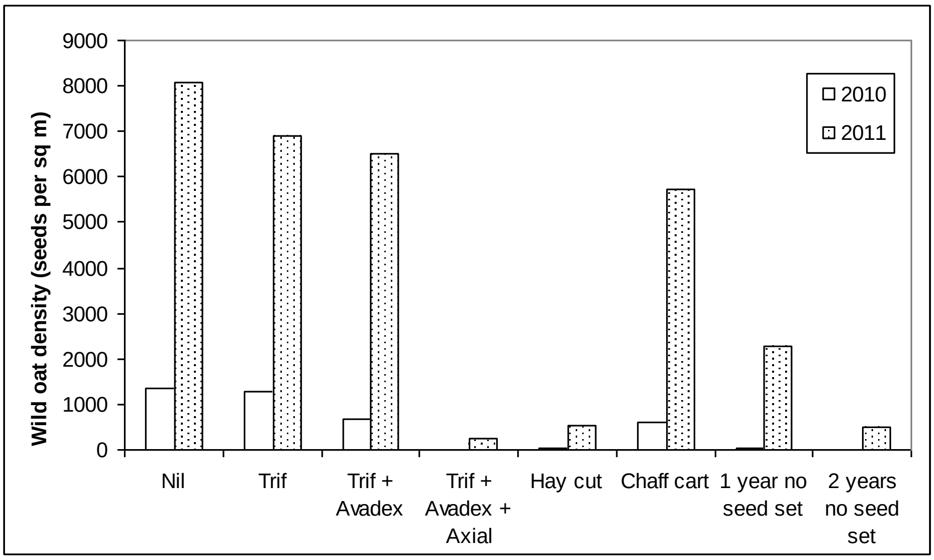


Figure 1: The effect of different management strategies on pre-sowing (March) wild oat seed density at Clare from 2010 to 2012.

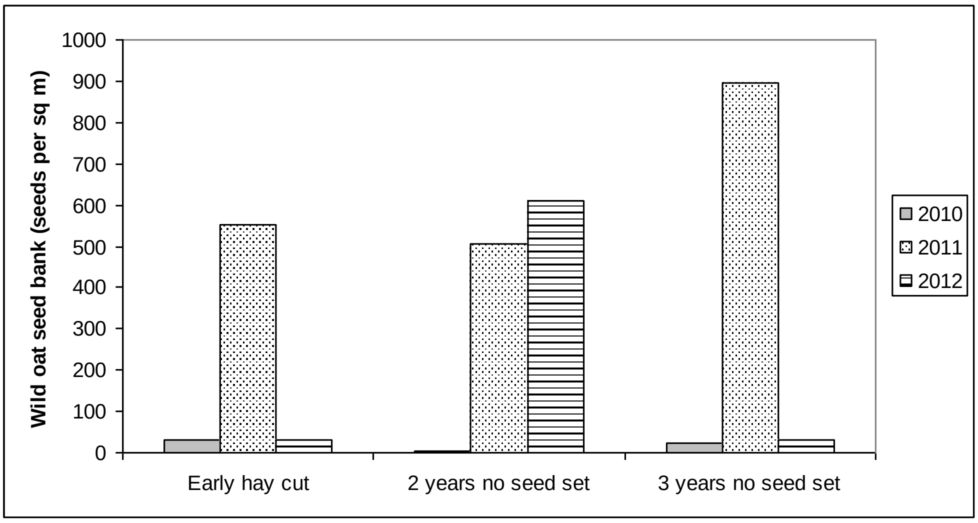


Figure 2: The effect of an early hay cut each year and 2 or 3 years of full seed set control on pre-sowing (March) wild oat seed density at Clare in 2012 only.

Acknowledgments

The Hart Field-Site Group wish to thank Andrew and Richard Hawker and Brian Jamieson for the use of their paddock and their cooperation with this trial work.


Early hay cut


Thick wild oats in canola

Wild oat control with pre-emergent herbicides in barley

This trial is funded by the GRDC and is part of a collaborative project. It was conducted with Sam Kleemann and Chris Preston, University of Adelaide and Peter Boutsalis, Plant Science Consulting.

Key findings

- A combination of Monza and Sakura applied PSPE provided the highest levels of wild oat control (68%)
- Even with good control a high weed density remained (>200 plants per square metre) which would still be expected to cause significant crop yield losses (90%)

Why do the trial?

The density of wild oats *(Avena fatua)* is increasing in the Mid North. This is due to an increase in cereal cropping intensity and the increase in herbicide resistance to Group A fop and dim herbicides. Also, traditional measures implemented for the control of annual ryegrass such as pre-emergent herbicides, export oaten hay, chaff carts and crop topping are generally less effective against wild oats.

This trial aims to evaluate the performance of new pre-emergent herbicides on the control of wild oats.

How was it done?

Plot size	1.75m x 8m	**Fertiliser**	27:12 (MAP/Urea) @ 100kg/ha 46:0 (Urea) @ 60kg/ha
Seeding date	29th May 2012	**Variety**	Commander barley @ 80kg/ha

This trial was established in a grower paddock, east of Clare (Hill River) on an existing patch of wild oats.

The trial was established as a randomised complete block design with 3 replicates and 10 herbicide treatments (Table 1). Active ingredients of the herbicides used in the trial are listed in Table 2.

Herbicides treatments were applied IBS (incorporated by sowing) prior to sowing of barley with a commercial seeder (i.e. knife-point & press wheels), or two days after (31st May) PSPE (post sowing pre-emergent) where listed.

Wild oats were counted 6 weeks after sowing using a 20cm × 30cm quadrat from 4 random locations within each plot.

Table 1. Pre-emergent herbicide treatments used at Clare in 2012.

Treatments		Cost ($/ha)
1	Nil (untreated control)	
2	Trifluralin 480 2.0L/ha	11.0
3	Trifluralin 480 2.0L/ha + tri-allate 3.0L/ha	38.0
4	Propyzamide 1.0kg/ha	23.0
5	Sakura 118g/ha	38.0
6	Sakura 177g/ha	57.0
7	Sakura 118g/ha + tri-allate 2.0L/ha	56.0
8	Monza 25g/ha (PSPE) + tri-allate 2.0L/ha	30.0
9	Sakura 118g/ha + Sakura 80g/ha (PSPE)	64.0
10	Monza 25g/ha (PSPE) + Sakura 80g/ha (PSPE)	38.0

Table 2. Pre-emergent herbicides & their active ingredients

Herbicide	Active ingredients	Herbicide group
Trifluralin 480	trifluralin 480g/L	D
Avadex Xtra	tri-allate 500g/L	J
Boxer Gold	prosulfocarb 800g/L + S-metolachlor 120g/L	J + K
Monza	sulfosulfuron 750g/L	B
Sakura (BAY-191 850WG)	pyroxasulfone 850g/kg	K

Results

The site had a high density of wild oats with 886 plants per square metre in the untreated plots. They were generally emerging from a soil depth of 2 to 3cm. All herbicide treatments reduced wild oat emergence and gave an average control of 52%, relative to the nil treatment (Figure 1). This is a low level of control and is likely to be a reflection on the very high nature of the starting seedbank.

A mixture of Monza and Sakura applied PSPE gave 68% control and propyzamide gave 67% control (Figure 1). Both of these treatments also gave improved reliability of control across the trial site. The only other treatment to give more than 50% control was trifluralin with tri-allate (57%).

The other treatments provided less than 50% control, with Sakura giving the poorest control (40%) when applied alone at 118g/ha. This is opposite to previous results measured in 2009 and 2010 where Sakura and Sakura mixtures provided the highest levels of wild oat control.

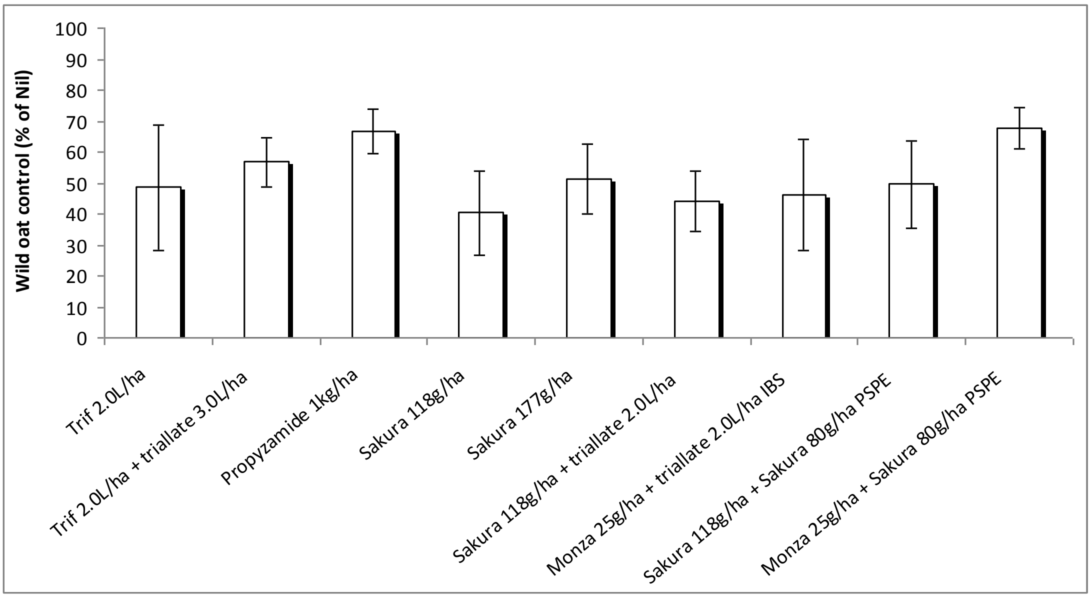


Figure 1: Effect of pre-emergent herbicide treatments on wild oat control relative to the nil treatment (untreated control).

Although the best treatments gave 68% control the weed density remaining was just over 200 wild oat plants per square metre. This would have still certainly caused significant crop yield losses (70%) and increased the weed seedbank. Post emergent herbicides would still have been required in addition to gain improved control.

Some of the herbicide treatments contain unregistered pesticides and application rates. The results within this document do not constitute a recommendation for that particular use by the author or author's organisations.

Acknowledgments

The Hart Field-Site Group wish to thank Kym and Donald Martin for the use of their barley crop and their cooperation with this trial work.

Control of annual ryegrass with pre-emergence herbicides

Sam Kleemann, Peter Boutsalis, Chris Preston & Gurjeet Gill, The University of Adelaide, School of Agriculture, Food & Wine, Waite Campus

Peter Hooper, Hart Field-Site Group

Key findings

- All pre-emergent herbicides provided excellent early control of ryegrass (≥86%) & good crop safety under the knife-point press wheel system
- Combination of trifluralin & Avadex Xtra followed by PSPE Boxer Gold provided greatest residual control, controlling more than 98% of ryegrass 12 weeks after sowing
- Boxer Gold applied PSPE has been shown to provide some additional in-row control of ryegrass

Why do the trial?

Given the importance placed on trifluralin for controlling annual ryegrass under current farming practices & growing incidence of ryegrass resistant to this Group D herbicide, there is an urgent need to identify alternate pre-emergent herbicide options. Consequently trials have been undertaken over several seasons (2003 to present) at the Hart field site to evaluate the efficacy & crop safety of alternate pre-emergent herbicides & their mixtures for the control of ryegrass in wheat.

How was it done?

Plot size	1.75m × 12m	**Fertiliser**	DAP Zn 2% @ 70kg/ha
Seeding date	30th of May 2012	**Variety**	Gladius wheat

The trial was established as a randomised complete block design with 3 replicates & 12 herbicide treatments (Table 2). Active ingredients of the herbicides used in the trial are listed in Table 1.

To ensure even annual ryegrass (ARG) establishment across the trial site ARG seed was broadcast at 25kg/ha ahead of seeding & tickled in with a shallow pass with the seeder prior to herbicide application. The ryegrass was previously harvested from commercial paddocks and is approximately 30% resistant to trifluralin.

A standard knife-point press wheel system was used to sow the trial on 22.5cm (9") row spacings.

Pre-sowing herbicides were applied within an hour of sowing & incorporated by sowing (IBS) the post-sowing pre-emergence (PSPE) herbicides were applied on the 31st May.

Table 1. Pre-emergent herbicides & their active ingredients

Herbicide	Active ingredients
Trifluralin 480	trifluralin 480g/L
Avadex Xtra	tri-allate 500g/L
Boxer Gold	S-metolachlor 120g/L + prosulfocarb 800g/L
Sakura	pyroxasulfone 850g/kg
Dual Gold	S-metolachlor 960g/L

Table 2. Pre-emergent herbicides, rates & timings at Hart in 2012.

	Treatments	**Cost ($/ha)**
1	Nil (untreated control)	
2	Trifluralin 480 1.5L/ha (IBS)	$8
3	Avadex Xtra 3.0L/ha (IBS)	$27
4	Sakura 118g/ha (IBS)	$38
5	Boxer Gold 2.5L/ha (IBS)	$33
6	Trifluralin 480 1.5L/ha + Avadex Xtra 2.0L/ha (IBS)	$26
7	Experimental 1 (IBS)	N/A
8	Avadex Xtra 2.0L/ha + Boxer Gold 2.5L/ha (IBS)	$51
9	Avadex Xtra 2.0L/ha + Sakura 118g/ha (IBS)	$56
10	Trifluralin 480 1.5L/ha + Avadex Xtra 2.0L/ha + Dual Gold 0.5L/ha (IBS)	$33
11	Trifluralin 480 1.5L/ha + Avadex Xtra 2.0L/ha (IBS) + Boxer Gold 1.5L/ha (PSPE)	$46
12	Boxer Gold 2.0L/ha (IBS) + Boxer Gold 1.5L/ha (PSPE)	$46

Results

Table 3. Effect of different pre-emergence herbicides on ryegrass plant & head density (plants per square metre) at Hart, 2012. Values in brackets are % control relative to unsprayed nil.

Herbicide treatments	Annual ryegrass				
	July		Aug		Oct
	plants/m² (% control)				heads/m²
Nil	174	-	254	-	254
Trifluralin	20	(89)	52	(80)	56
Avadex Xtra (AX)	7	(96)	37	(85)	35
Sakura (Sak)	25	(86)	31	(88)	6
Boxer Gold (BG)	8	(95)	33	(87)	19
Trif + AX IBS	9	(95)	26	(90)	17
Experimental 1	7	(96)	36	(86)	20
AX + BG IBS	8	(95)	21	(92)	7
AX + Sak IBS	8	(95)	10	(96)	5
Trif + AX IBS + DG PSPE	6	(97)	23	(91)	13
Trif + AX IBS + BG PSPE	2	(99)	4	(98)	7
BG IBS + BG PSPE	2	(99)	11	(96)	0
LSD (0.05)	16		21		22

Annual ryegrass was assessed on the 10th of July & 22nd of August, 6 & 12 weeks after sowing.

At the first time of assessment (early July) all of the herbicide treatments had significantly reduced ryegrass emergence, averaging 95% control (Table 3). However, by late August differences between the treatments could be measured.

In late August the average ryegrass control across the site was still 90%. At Hart in 2012 the overall performance from all of the pre-emergent herbicides was very good, with all treatments producing over 80% control. The control ranged from 80% (Trifluralin) to 98% (Trifluralin IBS + Avadex Xtra IBS + Boxer Gold PSPE), (Table 3).

In the 2012 Hart trial, treatments giving better than 90% overall control of ryegrass were:

- Trifluralin (480) 1.5L/ha + Avadex Xtra 2.0L/ha (IBS)
- Avadex Xtra 2.0L/ha + Boxer Gold 2.5L/ha (IBS)
- Avadex Xtra 2.0L/ha + Sakura 118g/ha (IBS)
- Trifluralin (480) 1.5L/ha + Avadex Xtra 2.0L/ha (IBS) + Dual Gold 0.5L/ha (IBS)
- Trifluralin (480) 1.5L/ha + Avadex Xtra 2.0L/ha (IBS) + Boxer Gold 1.5L/ha (PSPE)
- Boxer Gold 2.0L/ha (IBS) + Boxer Gold 1.5L/ha (PSPE)

The exact same treatments also produced the best ryegrass control in 2011. All herbicide treatments containing only one product gave significantly poorer control of ryegrass.

Final ryegrass head numbers were significantly greater (more than 30 heads per square metre) for the trifluralin and Avadex Xtra treatments when applied alone (Table 3). Treatments that included a PSPE application or Sakura had a final head number below 10 heads per square metre.

The final grain yield of wheat was not significantly different between the herbicide treatments, averaging 2.5t/ha.

In summary, the trial has again shown there are a number of effective pre-emergent herbicide options available for the effective control of Group D resistant ryegrass. Although these herbicides provide an alternative mode of action to trifluralin, they should be used in conjunction with robust management strategies that use a diverse rotation of crops, herbicides and non-chemical strategies (eg. chaff carts) so as to prolong the life of existing and new chemical groups against ryegrass.

Acknowledgements

This trial was funded by GRDC & conducted in collaboration between Birchip Cropping Group, The University of Adelaide & the Hart Field-Site Group.

Winter Walk 2012

Post sowing use of pre-emergent herbicides for annual ryegrass control

Sam Kleemann, Chris Preston, Gurjeet Gill & Peter Boutsalis, University of Adelaide, School of Agriculture, Food & Wine, Waite Campus

Peter Hooper, Hart Field-Site Group

Key findings

- Preliminary results have shown that post sowing use of some pre-emergence herbicides can improve control of late emerging ryegrass & could be beneficial as a late salvage exercise where ryegrass has escaped earlier control
- Although no damage to the wheat crop was observed, these treatments present a higher risk to crop safety, depending on soil type & rainfall after application
- Post sowing use of these herbicides is currently off label & requires further investigation before registration can be granted

Why do the trial?

While pre-emergence herbicides initially provided excellent control of ryegrass last year it was clearly evident from the amount of late germinating ryegrass that their residual activity had been exhausted by late winter, particularly in the medium to higher rainfall areas. This was not entirely unexpected given the more favourable growing season experienced across much of the South Australian wheat-belt.

Although late emerging ryegrass is less competitive with the crop, weed seed set can still be significant allowing it to replenish the weed seed bank and create management issues for the following crop. Given that the new pre-emergent herbicides on the market are relatively stable in the field, is there potential to improve residual control by applying post-sowing. Furthermore, post emergence use of these herbicides maybe beneficial as a late salvage exercise where ryegrass has escaped earlier control.

Consequently a trial has been undertaken at the Hart field site to evaluate the efficacy of pre-emergent herbicides applied post sowing on ryegrass control & crop safety in wheat with the aim of a) increasing residual control, b) improving in-row control & c) preventing onset of trifluralin resistance.

How was it done?

Plot size	1.4m × 10m	**Fertiliser**	DAP Zn 2% @ 70kg/ha
Seeding date	30th of May 2012	**Variety**	Gladius wheat

The trial was established as a randomised complete block design with 3 replicates and 12 herbicide treatments (Table 1).

To ensure even annual ryegrass (ARG) establishment across the trial site ARG seed was broadcast at 25kg/ha ahead of seeding and tickled in with a shallow pass with the seeder prior to herbicide application. The ryegrass used was harvested from grower paddocks and is approximately 30% resistant to trifluralin.

A standard knife-point press wheel system was used to sow the trial on 22.5cm (9") row spacings.

Post-sowing pre-emergence (PSPE) herbicides were applied on the 31st of May, the day after sowing & post emergence treatments when the ryegrass was at the 1 to 3 leaf growth stage & just prior to rainfall.

Herbicides rates applied:

- Boxer Gold @ 1.5L/ha or 2.5L/ha
- Sakura @ 80g/ha or 118g/ha
- Dual Gold @ 350ml/ha or 500ml/ha

Herbicide timing of application:

- post sowing pre-emergent (PSPE) on the 31st May, 1 day after sowing. The site received 4mm of rainfall within the next week after the PSPE applications
- post emergent application treatments were applied on the 20th July, when the ryegrass growth stage was between 1 and 3 leaves. The site received 8mm of rainfall 8 days after the treatments were applied

Crop emergence was assessed by counting the number of emerged wheat seedlings along both sides of a 0.5m rod at 3 random locations within each plot. Ryegrass was counted at 6 & 10 weeks after sowing (i.e. July & August) using a 0.1 square metre quadrat from within and between the crop rows from 4 random locations within each plot.

Results

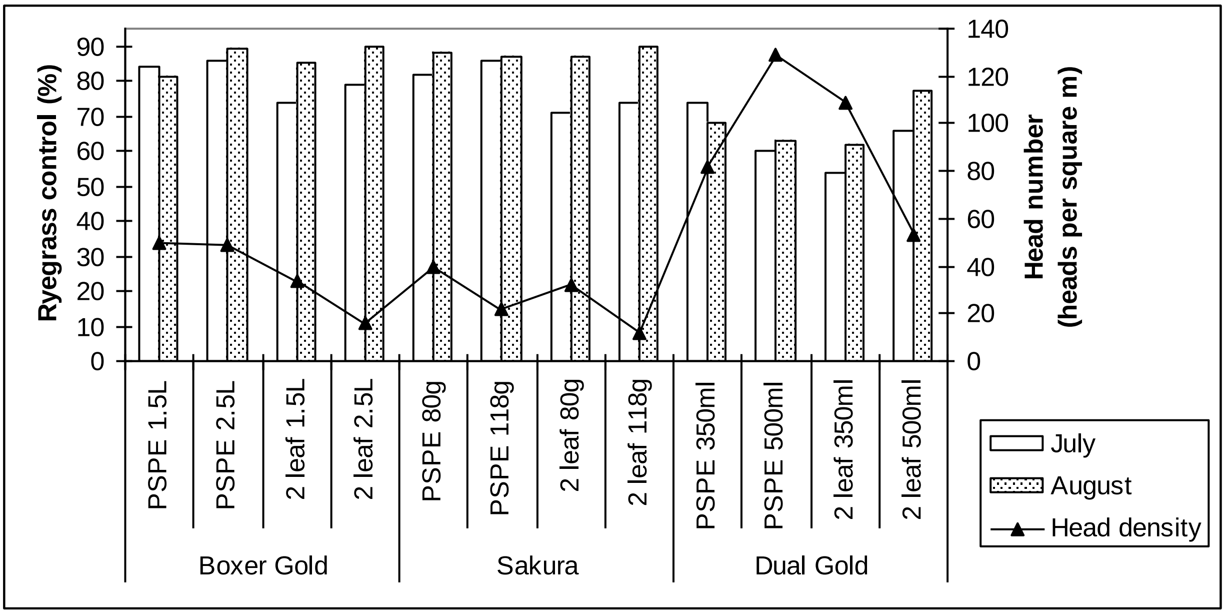


Figure 1: Effect of post-sowing use of pre-emergence herbicides on annual ryegrass control (%) & head density (heads per square metre) in wheat at Hart, 2012. Values in brackets are % control relative to unsprayed nil from the adjoining trial (July = 174 ARG plants per square metre; August = 254 ARG plants per square metre).

In August the ryegrass control ranged from 62% (Dual Gold, 500ml, 2 leaf) to 90% control (Boxer Gold, 2.5L, 2 leaf or Sakura, 118g, 2 leaf) (Figure 1). Dual Gold at any rate or timing produced significantly lower ryegrass control compared to Boxer Gold or Sakura. Average control for the Dual Gold was 68%.

Boxer Gold and Sakura gave very similar control, averaging 87% control. Boxer Gold applied PSPE at only 1.5L gave poorer control (81%), compared to the other Boxer Gold and Sakura treatments. For both products ryegrass control improved with herbicide rate. Compared to 2011, Sakura has produced much better ryegrass control when applied at the 1 leaf stage, at any rate.

Sakura generally gave the best control of ryegrass head numbers, averaging 27 heads per square metre, compared to 37 for Boxer Gold and 93 for Dual Gold (Figure 1). For Boxer Gold and Sakura control of ryegrass heads improved with the higher application rate and the latest timing.

Some of the herbicide treatments contain unregistered pesticides and application rates. The results within this document do not constitute a recommendation for that particular use by the author or author's organisations.

Acknowledgements

This trial was funded by GRDC & conducted in collaboration with Birchip Cropping Group & The University of Adelaide.

View of the site, Hart Field Day 2012

Improving the efficacy of clethodim herbicide against annual ryegrass

Sam Kleemann, Chris Preston, Gurjeet Gill & Peter Boutsalis, University of Adelaide, School of Agriculture, Food & Wine, Waite Campus

Peter Hooper, Hart Field-Site Group

Key findings

- Clethodim applied at 500ml/ha to ryegrass at the 2 to 3 leaf stage averaged 84% control
- Two early applications, ryegrass at 2 to 3 leaf and then again 3 weeks later, gave the best control of resultant ryegrass head numbers
- All combinations of clethodim and butroxydim applied after ryegrass reached the 2 to 3 leaf stage significantly reduced grain yield

Why do the trials?

Group A herbicides are very important for the selective control of grass weeds in both crops & pastures. However, annual ryegrass has shown widespread resistance to the Group A 'fop' herbicides (i.e. Hoegrass) for many years and dealing with is now is part of managing modern cropping systems in southern Australia. One of the consequences of this has been the heightened reliance on the 'dim' chemistry of Group A herbicides (i.e. Select) for providing selective control in both pulse & oilseed crops. Dim herbicides until recent have been extremely effective against ryegrass; however there appears to be a growing number of populations showing resistance to this important group of herbicides (Boutsalis pers. comm.). As a consequence use rates of herbicides like clethodim have dramatically increased by more than 2-fold (i.e. 500ml/ha) the recommended label rate (250ml/ha).

Importantly where populations of ryegrass are still susceptible to 'dim' herbicides like clethodim it is critical to ensure that they are used under optimal conditions to maximise weed kill. Dim herbicides, like the fops, move very slowly within the plant & so need to be applied under favourable growing conditions to ensure maximum activity & weed control. Spraying after a frost or in overcast & cold conditions can adversely affect herbicide performance. Furthermore, it is critical to maximise spray coverage so as to ensure plants receive a lethal dose of herbicide. By optimising herbicide use there should be fewer survivors which will help reduce the potential for resistance development & prolong the effectiveness of this very important chemistry.

Given the increasing reliance & importance of 'dim' herbicides in the management of annual ryegrass a field trial was established at Hart to investigate the factors influencing (i.e. ryegrass size) performance of 'dim' herbicides Select (a.i. clethodim) & Factor (a.i. butroxydim) on Group A resistant ryegrass in canola.

How was it done?

Plot size	1.75m × 12m	**Fertiliser**	DAP Zn 2% @ 80kg/ha
Seeding date	31st of May 2012	**Variety**	Clearfield canola

Trials were established in canola to evaluate a) the impact of herbicide timing & ryegrass size on performance of clethodim & its tank mixture with butroxydim & b) the efficacy of clethodim on annual ryegrass following a range of weather conditions.

The range of herbicide timings for application determined for the treatments are shown in Tables 1 & 2. As an additional treatment, UAN (Urea Ammonium Nitrate) was used as the carrier with water, rather than water alone & applied with herbicides clethodim & butroxydim when the ryegrass was initially at 2-3 leaf stage (20th July) & again at 4-leaf to early tillering stage (16th August). The timing for 6 weeks after the 2 to 3 leaf stage was the 6th September. UAN was used at 20L/ha (8kg N/ha) & made up to a 100L/ha spray volume with rainwater. All treatments were applied using a handheld boom fitted with nozzles delivering a medium droplet spectrum & a spray volume of 100L/ha.

To ensure even annual ryegrass (ARG) establishment across the trial site ARG seed was broadcast at 10kg/ha ahead of seeding & tickled in with a shallow pass with the seeder. The ryegrass population at the site was known to be resistant to Group A fop herbicides, and partially resistant to the dim herbicides. The trial design was a randomised complete block with three replicates.

Annual ryegrass head density was assessed on 31st October.

Table 1. Herbicide mixtures, rates & timings for ryegrass control in canola (Note 1 % Hasten plus 2% Liase was used in each treatment).

Treat	Herbicide	*Rate/ha	Timing
1	clethodim	500ml	-
2	clethodim + butroxydim	500ml + 80g	-
3	clethodim	500ml	Ryegrass 2-3 leaf
4	clethodim + butroxydim	500ml + 80g	Ryegrass 2-3 leaf
5	clethodim	500ml	3 weeks after ryegrass 2-3 leaf
6	clethodim + butroxydim	500ml + 80g	3 weeks after ryegrass 2-3 leaf
7	clethodim	500ml	6 weeks after ryegrass 2-3 leaf
8	clethodim + butroxydim	500ml + 80g	6 weeks after ryegrass 2-3 leaf
9	clethodim	500ml	Ryegrass 2-3 leaf + 3 weeks after ryegrass 2-3 leaf
10	clethodim + butroxydim	500ml + 80g	Ryegrass 2-3 leaf + 3 weeks after ryegrass 2-3 leaf
11	clethodim	500ml	Ryegrass 2-3 leaf + 6 weeks after ryegrass 2-3 leaf
12	clethodim + butroxydim	500ml + 80g	Ryegrass 2-3 leaf + 6 weeks after ryegrass 2-3 leaf
13	clethodim + UAN	500ml + 20L	Ryegrass 2-3 leaf + 3 weeks after ryegrass 2-3 leaf
14	clethodim + butroxydim + UAN	500ml + 80g + 20L	Ryegrass 2-3 leaf + 3 weeks after ryegrass 2-3 leaf

*Application of clethodim at 500ml/ha is not a registered rate & was undertaken for experimental purposes. UAN is not registered as a carrier for clethodim or butroxydim.

Results

Ryegrass counts in August and September showed that clethodim applied at 500ml/ha to ryegrass at the 2 to 3 leaf stage averaged 84% control. The addition of butroxydim improved this control to 91% (Table 3). Applying the same herbicide treatments 3 weeks later only marginally reduced the ryegrass control.

Two applications of clethodim and butroxydim alone or in combination increased ryegrass control by 5%, at both application timings. The addition of 20L/ha of UAN increased control by another 2 to 5%, averaging 96% control.

Two early applications, ryegrass at 2 to 3 leaf and then again 3 weeks later, gave the best control of resultant ryegrass head numbers. As herbicide applications were delayed for longer, the number of heads formed increased i.e control was less.

The best herbicide treatments reduced ryegrass head numbers to below 5 heads per square metre, however, the average number of heads set were 17 heads per square metre. This still represents a significant quantity of ryegrass seed (potentially resistant) and so further harvest seed set control and other integrated weed management strategies would certainly be required.

All combinations of clethodim and butroxydim applied after ryegrass reached the 2 to 3 leaf stage significantly reduced grain yield (Figure 1). The stress induced by both the herbicides is well known, and the damage is understood to increase with later applications, closer to green bud development.

Table 3. Effect of herbicide clethodim & its tank mixture with butroxydim, applied at various timings to control annual ryegrass in canola at Hart, 2012. Values in brackets are % control relative to unsprayed treatments (T1 & T2 = Aug, 49 ARG plants per square metre; Sep, 53 ARG plants per square metre).

	Annual ryegrass					
	July	August		September		October
Herbicide treatments	plants/m² (% control)					heads/m²
1	53	50	-	57	-	91
2	45	47	-	49	-	118
3	32	6	(88)	11	(79)	14
4	35	4	(92)	5	(91)	4
5	43	28		12	(77)	33
6	50	37		6	(89)	8
7	47	39		56		66
8	52	51		49		36
9	36	10	(80)	6	(89)	5
10	48	4	(92)	2	(96)	0
11	35	46		10	(81)	25
12	41	51		8	(85)	5
13	46	5	(90)	3	(94)	10
14	44	3	(94)	1	(98)	1
LSD (0.05)	NS	15		13		23

Refer to Table 1 for herbicide rates & timings.

Where values are not given in parenthesis (% control), herbicide applied within a week of assessment.

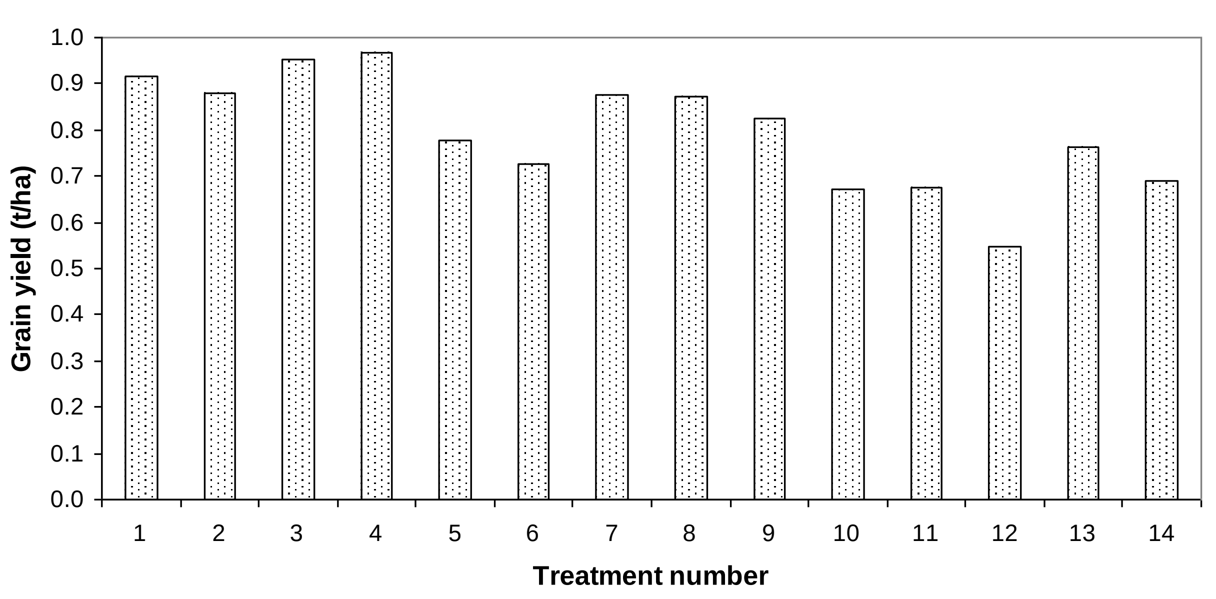


Figure 1: Effect of herbicide clethodim & its tank mixture with butroxydim, applied at various timings on grain yield response of canola at Hart, 2012. Refer to Table 1 for information on herbicide treatments (1-14). Bar represents LSD (0.05) = 132.

Some of the herbicide treatments contain unregistered pesticides, application rates and timings. The results within this document do not constitute a recommendation for that particular use by the author or author's organisations.

Suggestions for optimising control

- Always apply at correct herbicide rates & with appropriate adjuvants (see label recommendations).
- Efficacy is improved when applying to ryegrass around the 4-leaf to early tillering development stage. This will help ensure adequate spray coverage & herbicide uptake.
- Dim herbicides perform better in mild to warm conditions when the crop & weeds are actively growing, avoid using when conditions are cold & overcast or very dry.
- Avoid spraying for 2 to 3 days before a frost.
- There is some evidence that water quality can reduce herbicide efficacy, addition of ammonium sulphate can be beneficial when using hard water (i.e. high in bicarbonates).
- Ensure good spray coverage by using water rates of 80 to 100L/ha.

Acknowledgements

This trial was funded by GRDC & conducted in collaboration with Hart & Birchip Cropping Groups & The University of Adelaide.

Control of clethodim resistant ryegrass with pre-emergent herbicides

Sam Kleemann, Chris Preston, Gurjeet Gill & Peter Boutsalis, University of Adelaide, School of Agriculture, Food & Wine, Waite Campus

Peter Hooper, Hart Field-Site Group

Key findings

- Measurements in August showed clethodim to give 82% control and pre-emergent treatments to give 85% control of annual ryegrass
- Averaged across the trial the ryegrass still set 15 heads per square metre

Why do the trials?

With an increasing reliance and importance of group A 'dim' herbicides in the management of annual ryegrass a field trial was established at Hart to investigate various pre-emergent options to improve the control of Group A resistant ryegrass in canola.

How was it done?

Plot size	1.75m × 12m	**Fertiliser**	DAP Zn 2% @ 80kg/ha
Seeding date	31st of May 2012	**Variety**	Clearfield canola

Trials were established with canola to evaluate the efficacy of pre-emergent herbicides on the control of Group A resistant ryegrass.

The range of pre-emergent herbicides, rates and timings for application are shown in Table 1. All treatments were applied using a handheld boom fitted with nozzles delivering a medium droplet spectrum and a spray volume of 100L/ha.

To ensure even annual ryegrass (ARG) establishment across the trial site ARG seed was broadcast at 10kg/ha ahead of seeding & tickled in with a shallow pass with the seeder. The ryegrass population at the site was known to be resistant to Group A fop herbicides, and partially resistant to the dim herbicides.

Pre-sowing herbicides were applied within an hour of sowing & incorporated by sowing (IBS), the post-sowing pre-emergence (PSPE) herbicides were applied on the 31st May.

The PSPE treatments targeted before rainfall were applied on the 19th June and received 25mm on the 22nd June. Another 15mm rain fell on the 10th July. At the application timing the ryegrass was at 1 to 3 leaves.

Annual ryegrass head density was assessed on 31st October.

Table 1. Pre-emergence herbicides, rates & timings in canola at Hart in 2012

Treatments	
1	Trifluralin 480 1.5L/ha + tri-allate 3.0L/ha (IBS)
2	Experimental 1 (IBS)
3	Outlook 1.0L/ha (IBS)
4	Outlook 0.7L/ha (IBS) + 0.5L/ha (PSPE)
5	Propyzamide 1.0kg/ha 50% (IBS) + 50% (PSPE)
6	Propyzamide 1.0kg/ha 50% (PSPE) + 50% (3-4 leaf) + clethodim 0.5L/ha (POST)
7	Propyzamide 1.0kg/ha (PSPE – before rain)
8	Propyzamide 1.0kg/ha (3-4 leaf) + clethodim 0.5L/ha (POST)
9	Dual Gold 0.5L/ha 50% (IBS) + 50% (PSPE)
10	Dual Gold 0.5L/ha 50% (PSPE) + 50% (3-4 leaf) + clethodim 0.5L/ha (POST)
11	Dual Gold 0.5L/ha (PSPE – before rain)
12	Dual Gold 0.5L/ha (3-4 leaf) + clethodim 0.5L/ha (POST)
13	clethodim 0.5L/ha (POST)
14	butroxydim 180g/ha (POST)
15	clethodim 0.5L/ha + butroxydim 180g/ha (POST)

*Application of clethodim at 500ml/ha is not a registered rate & was undertaken for experimental purposes.

Results

The pre-emergent herbicides included in this trial all performed very well and could provide some promising options for the control of Group A resistant ryegrass. The ryegrass measurements in August showed clethodim to give 82% control and when applied with a full rate of butroxydim gave 96% control (Table 2).

The pre-emergent herbicide combinations were also able to achieve this level of control with trifluralin and tri-allate, Outlook and propyzamide all producing over 85% control. 1.0kg/ha of propyzamide split equally between seeding and PSPE gave 96% control (Table 2).

The herbicide treatments that include IBS applications or a clethodim treatment provided the best ryegrass control. The treatments that relied mainly on PSPE applications were generally poorer.

By October, the best herbicide treatments were able to reduce ryegrass head numbers down to below 5 heads per square metre. These treatments included Outlook and Dual Gold split between IBS and PSPE timings, and propyzamide also in a split timing and included with clethodim (Table 2). Propyzamide applied after the PSPE timing and the full rate of Dual Gold applied PSPE produced the most ryegrass heads, due to their poor early control.

Averaged across the trial the ryegrass managed to set 15 heads per square metre, or 15,000 heads per hectare. This is a large and significant potential for seed set, meaning extra integrated weed management strategies will be required to reduce ryegrass numbers.

Table 2. Effect of different pre-emergence herbicides on annual ryegrass control (%) & head density (no./m²) in canola at Hart, 2012. Values in brackets are % control relative to unsprayed treatments (July - T13, T14 & T15 = 36 ARG plants/m²; August – adjoining trial = 49 ARG plants/m²).

	Annual ryegrass				
	July		August		October
Herbicide treatments	plants/m² (% control)				heads/m²
1	5	(86)	5	(90)	10
2	3	(92)	4	(92)	11
3	5	(86)	6	(88)	8
4	2	(94)	6	(88)	2
5	3	(92)	2	(96)	8
6	26	(28)	3	(94)	4
7	22	(39)	26	(47)	53
8	50	(0)	16	(67)	18
9	9	(75)	4	(92)	5
10	41	(0)	5	(90)	10
11	33	(9)	36	(26)	62
12	34	(6)	6	(88)	10
13	32	-	9	(82)	11
14	38	-	12	(75)	14
15	39	-	2	(96)	1
LSD (0.05)	14		7		15

Some of the herbicide treatments contain unregistered pesticides, application rates and timings. The results within this document do not constitute a recommendation for that particular use by the author or author's organisations.

Acknowledgements

This trial was funded by GRDC & conducted in collaboration with Hart & Birchip Cropping Groups & The University of Adelaide.

Group B tolerant crops

Key findings

- New crop varieties have been recently released that have improved tolerance to imidazoline (imi) herbicides
- Group B tolerant varieties showed only slight damage symptoms to herbicides registered for use. Damage to non-group B tolerant varieties was observed in many treatments

Why do the trial?

To compare the tolerance of the new varieties to a range of group B herbicides relative to conventional non-tolerant varieties. To also measure the efficacy of herbicides for controlling crop volunteers with group B tolerance.

How was it done?

Plot size	2m x 3m	**Fertiliser**	50kg/ha DAP Zn 2%
Seeding date	12th June 2012		

The crops included:

- 2 strips of canola were sown. AV Garnet (not tolerant) & Clearfield 43C80 (tolerant).
- 2 strips of barley were sown. Buloke (not tolerant) & Scope (tolerant).
- 3 strips of wheat were sown. Gladius (not tolerant), Justica CL plus & Clearfield JNZ (tolerant).
- 2 strips of lentils were sown. Nipper (not tolerant) & PBA Herald XT (tolerant).

The herbicide treatments for all the crops included:

- 2 residual herbicide treatments were applied prior to sowing
- 5 group B post emergent (3-4 leaf or node) herbicide treatments applied 18th July
- 4 group H, I or G post emergent (3-4 leaf or node) herbicide treatments applied 18th July

Treatments were visually assessed and scored for herbicide damage symptoms 5 weeks after application.

Results

Many of the herbicides are not registered for the crops that have been sprayed. It is important to check the herbicide label before following strategies used in this demonstration. Herbicide effects can vary between seasons and depend on soil and weather conditions at time of application.

There were only slight effects to the tolerant crop lines of wheat, barley, canola and lentils from the residual herbicide treatments. Damage to the non-tolerant lines ranged from moderate to severe.

For the tolerant wheat the post emergent applications of group B herbicides gave no effect. Whereas for the barley post emergent Intervix and Spinnaker produced slight effects. There was no visual difference in the new wheat variety Justica CL Plus (twin gene) compared to the older Clearfield JNZ (single gene).

Post emergent Logran at 10kg/ha produced a moderate effect in the tolerant canola. Spinnaker, Raptor or Intervix produced no effect.

PBA Herald XT (formally CIPAL 702) the new lentil variety released for improved tolerance to Broadstrike and group B herbicide residues was slightly affected by all of the post emergent group B herbicides. Other research conducted by SARDI has previously demonstrated that certain group B herbicides and their residues can cause significant damage symptoms to PBA Herald XT. Nipper (non tolerant) lentils incurred a moderate to severe level of damage to both residual and post timing applications of group B herbicides.

The 700 ml/ha rate of Intervix resulted in severe effects or death of the non tolerant varieties Nipper, Buloke, Gladius and AV Garnet. Tolerant varieties Herald XT, Scope, Justica CL Plus, Clearfield JNZ and 44C79 were not affected.

The broadleaf herbicide treatments used to control the herbicide tolerant lines included Precept, Conclude, Banvel M, Affinity Force and 2,4-D Amine. The treatments produced severe effects or death to the tolerant lentil and canola lines and satisfactory control.

			Lentil		Barley		Wheat			Canola	
			Not Tol	Tol	Not Tol	Tol	Not Tol	Tol	Tol	Not Tol	Tol
Timing	Herbicide	Row	Nipper	Herlad XT	Buloke	Scope	Gladius	Justica CL	Clf JNZ	Garnet	43C80
	Nil	1	1	1	1	1	1	1	1	1	1
Residual	7g logran	2	4	1	3	2	2	1	1	4	1
3-4 leaf or node	10g logran	3	4	2	2	1	2	1	1	5	3
Residual	180mL Intervix	4	3	1	2	1	3	2	2	1	1
3-4 leaf or node	Intervix 700mL	5	3	1	4	2	4	1	1	5	1
3-4 leaf or node	Raptor 45g	7	3	1	4	1	4	1	1	4	1
3-4 leaf or node	Spinnaker 100g	8	3	2	4	2	4	1	1	4	1
3-4 leaf or node	Precept 750mL	9	4	4	1	1	1	1	1	5	5
3-4 leaf or node	Conclude 700mL	10	4	4	1	1	1	1	1	5	5
3-4 leaf or node	Banvel M 1.0L	11	4	4	1	1	1	1	1	4	4
3-4 leaf or node	Affinity	12	4	4	2	2	1	1	1	4	5
3-4 leaf or node	2,4-D 1.0L	13	5	4	1	1	1	1	1	4	4

Crop damage ratings:
1 = no effect
2 = slight effect
3 = moderate effect
4 = severe effect
5 = death

Legume and oilseed herbicide tolerance

Key findings

- A wet June meant that many of the PSPE treatments like simazine at 850g/ha, diuron 410g/ha with simazine 410g/ha or Terbyne 1kg/ha produced more damage compared to normal
- Group B tolerant Angel medic does not tolerate Logran, Ally or Eclipse post emergent

Why do the trial?

To compare the tolerance of legume and canola varieties to a range of herbicides and timings.

How was it done?

Plot size	2m x 3m	**Fertiliser**	DAP @ 50 kg/ha + 2% Zinc
Seeding date	12th June 2012		

13 strips of canola, pasture, vetch, chickpea, faba bean, field pea and lentils were sown. 58 herbicide treatments were applied across these crops at 4 different timings.

The timings were:

Incorporated by sowing (IBS)	12th June
Post seeding pre-emergent (PSPE)	18th June
Early post emergent (3-4 node)	18th July
Post emergent (5-6 node)	3rd August
Late post emergent (9 node)	20th August

Treatments were visually assessed and scored for herbicide effects 4 and 6 weeks after application.

Crop damage ratings were:

1 = no effect
2 = slight effect
3 = moderate effect
4 = severe effect
5 = death

Results

> Many of the herbicides are not registered for the crops that have been sprayed. It is important to check the herbicide label before following strategies used in this demonstration. Herbicide effects can vary between seasons and depend on soil and weather conditions at time of application.

The pre-emergent herbicides Boxer Gold, Sakura and propyzamide were incorporated by sowing in 2012. It should be pointed out that for these pre-emergent herbicides, many are not currently registered for many of the crop types in the trial.

Sakura produced moderate to severe effects on all 3 canola and pasture varieties and slight effects on the pea, bean and lentil varieties. Boxer Gold also produced a slight effect on the lentil and pasture varieties.

Propyzamide (500g/kg) more commonly known as Kerb or Edge was included in the trial for the first time in 2011 as an early post emergent application. This year it was applied IBS and no damage symptoms were scored in any of the canola or legume varieties, similar to last year.

The Sakura, propyzamide and simazine treatments all gave very good control of the volunteer oats across the site in 2012.

Of the PSPE treatments simazine at 850g/ha, diuron 410g/ha with simazine 410g/ha or Terbyne 1kg/ha produced more damage to both lentil varieties, compared to normal. This might be partly due to a wet June. All of the PSPE treatments were particularly damaging to the pasture varieties.

In the early post emergent (3 to 4 node) treatments Brodal Options 150ml/ha or Brodal Options 150ml/ha with MCPA amine 150ml/ha produced moderate damage to both lentil varieties. These treatments also produced slight damage on the Gunyah peas. Gunyah peas were also damaged by early post emergent metribuzin 280g/ha and also MCPA Sodium 700ml at the 9 node stage, which also occurred in 2011.

In the post emergent treatments a range of herbicides produced very good control of all the non-herbicide tolerant legume species. These included Eclipse, Affinity, Conclude, Precept, Velocity, Flight, Banvel M, Hussar, Crusader, Atlantis and Lontrel. Ecopar tended to give slightly poorer control compared to Affinity on canola and legumes. However, it was much safer on the pasture legumes and gave no damage to the balansa clover.

The group B herbicide tolerant Angel medic was included again in 2012. It showed very good tolerance to PSPE or post Spinnaker and Raptor. However, as shown in previous trials it does not tolerate Logran, Ally or Eclipse. Intervix only damaged it slightly.

There was little differentiation between knockdown herbicides in 2012, with all treatments providing good levels of control on legumes and canola. Glyphosate applied alone at 1.0L/ha gave the slowest rate of control, even though the final result was similar to the other knock down treatments.

4 weeks after application of the paraquat treatments the chickpeas had started to re-shoot. After 7 weeks the beans, vetch and lentils were also re-shooting through this treatment.

The glyphosate treatments with the addition of either Amicide Advance or Cadence maintained complete control for the entire season.

Legume & Canola Herbicide Tolerance

Sown: 12/06/12

				Canola			Bean	Pea	C/pea	Vetch		Lentil		Pasture		
				43C80	Cobbler	Garnet	Farah	Gunya	Genesis 090	Capello	Rasina	PBA Herald XT	Flash	Wilpena Sulla	Frontier Balansa	Angel
		Treatment	Rate kg/ha	5	5	5	140	100	80	45	45	45	55	15	15	10
IBS (12/06/12)	1	Nil		1	1	1	1	1	1	1	1	1	1	1	1	1
	2	Boxer gold	2500mL	1	1	1	1	1	1	1	1	2	2	1	2	2
	3	Sakura	118g	3	3	4	2	2	1	2	1	2	2	3	5	2
	4	Propyzimide	1000mL	1	1	1	1	1	1	1	1	1	1	1	1	1
PSPE (18/06/12)	1	Diuron	850g	2	3	1	1	1	1	2	1	2	2	4	5	3
	2	Simazine	850g	5	1	2	1	1	2	2	1	3	3	5	5	5
	3	Diuron + Simazine	410g/410g	4	2	4	1	1	2	2	1	3	3	5	5	5
	4	Metribuzin	280g	5	3	4	2	1	1	5	2	4	4	4	5	5
	5	Terbyne	1000g	5	2	5	1	1	1	1	1	4	4	5	5	5
	6	Spinnaker	70g	1	5	5	1	1	1	1	1	1	1	3	2	1
	7	Spinnaker + Simazine	40g/850g	5	4	5	1	1	2	1	1	3	3	5	5	5
	8	Balance	100g	5	5	5	4	4	1	5	4	5	5	5	5	5
	9	Balance + Simazine	100g/830g	5	5	5	4	4	3	5	4	5	5	5	5	5
3-4 node (18/07/12)	1	NIL		1	1	1	1	1	1	1	1	1	1	1	1	1
	2	Simazine	850g	2	2	2	1	1	3	2	2	2	2	2	4	4
	3	Metribuzin	280g	5	1	5	1	3	3	4	2	2	2	2	5	5
	4	Broadstrike	25g	1	4	4	3	1	2	3	2	1	1	2	2	1
	5	Brodal Options	150ml	3	4	3	3	2	4	3	3	3	3	5	3	3
	6	Brodal Options + MCPA Amine	150ml/150ml	4	5	3	4	2	4	4	4	3	3	5	3	3
	7	Sniper 750WG	50g	3	3	2	4	2	4	4	3	2	2	5	3	3
	8	Spinnaker + wetter	70g/0.2%	1	5	5	1	1	3	2	3	1	4	2	4	1
	9	Raptor + wetter	45g/0.2%	1	5	5	1	2	4	2	3	2	4	1	4	1
5-6 node (03/08/12)	1	NIL		1	1	1	1	1	1	1	1	1	1	1	1	1
	2	Logran+wetter	10g/0.1%	3	4	4	4	4	4	4	4	4	4	2	5	3
	3	Ally + wetter	7g/0.1%	3	4	4	4	4	4	4	4	4	5	4	5	4
	4	Eclipse SC + Uptake	50ml/0.5%	3	5	5	4	4	4	4	4	4	4	3	5	4
	5	Ecopar + MCPA Amine	400ml/500ml	4	4	4	4	3	4	4	4	4	4	2	1	2
	6	Affinity Force + MCPA Amine	100ml/500ml	5	5	5	5	4	5	4	5	4	4	4	4	4
	7	Conclude + Uptake	700ml/0.5%	5	5	5	4	4	4	5	5	5	5	4	5	4
	8	Precept + Hasten	750ml/1%	5	5	5	4	4	4	5	5	5	5	4	5	5
	9	Velocity + Hasten	670ml/1%	5	5	5	4	5	5	5	5	5	5	5	5	5
	10	Flight EC	720ml	5	5	5	5	4	5	5	5	5	5	5	3	4
	11	Banvel M	1L	4	4	4	4	4	4	5	5	5	5	4	4	4
	12	Intervix + Hasten	600ml/1%	1	5	5	4	4	4	4	4	3	4	4	5	2
	13	Hussar OD + wetter	100ml/0.25%	4	5	5	4	4	5	5	5	4	5	5	5	4
	14	Crusader + wetter	500ml/0.25%	2	5	5	4	4	4	4	4	5	5	4	5	4
	15	Atlantis OD + Hasten	330ml/0.5%	3	5	5	4	4	4	4	4	3	4	4	4	4
	16	Atrazine + Hasten	833g/1%	5	2	5	4	4	5	4	4	5	5	4	5	5
	17	Lontrel 600	150ml	1	1	1	4	4	5	5	5	5	5	4	4	4
	18	Starane	300ml	2	2	1	4	4	4	4	4	4	4	1	2	2
9 node (20/08/12)	1	MCPA Sodium	700ml	4	3	3	4	3	3	3	3	3	3	2	2	1
	2	MCPA Amine	350ml	3	4	4	4	3	4	3	3	4	3	2	2	2
	3	Amicide Advance 700	1.2L	4	4	4	4	4	4	4	4	4	4	2	2	2
	4	2,4-D Ester	70ml	3	4	4	3	4	4	3	3	3	3	1	2	2
3-4 node (03/08/12)	1	NIL		1	1	1	1	1	1	1	1	1	1	1	1	1
	2	Sprayseed	2L	5	5	5	4	5	3	4	5	5	5	4	5	5
	3	Gramoxone	1L	5	5	5	4	5	4	4	4	4	4	4	5	5
	4	Glyphosate	1L	5	5	5	4	5	4	4	4	5	5	5	5	5
	5	Glyphosate + LVE 680	1L/500ml	5	5	5	4	5	4	4	5	5	5	5	5	5
	6	Glyphosate + Amicide Advance 70	1L/650ml	5	5	5	4	5	4	5	5	5	5	5	5	5
	7	Glyphosate + Ecopar	1L/150ml	5	5	5	5	5	4	4	4	5	5	5	5	5
	8	Glyphosate + Hammer	1L/50ml	5	5	5	4	5	4	4	4	5	5	5	5	5
	9	Glyphosate + Cadence	1L/115g	5	5	5	4	5	4	5	5	5	5	5	5	5
	10	Glyphosate + Pyresta	1L/400ml	5	5	5	4	5	4	5	5	5	5	5	5	5
	11	Glyphosate +Sharpen	1L/18g	5	5	5	4	5	4	4	4	5	5	4	5	5
	12	Glyphosate + Valor	1L/30g	5	5	5	4	5	4	4	4	5	5	5	5	5
	13	Glyphosate + Goal	1L/75mL	5	5	5	4	5	4	4	4	5	5	5	5	5
	14	Glyphosate // Sprayseed 3DAS	1.2L//1.2L	5	5	5	4	5	4	4	4	5	5	5	5	5
	15	NIL		1	1	1	1	1	1	1	1	1	1	1	1	1

The control of summer weeds using larger spray droplets and more adverse weather conditions

Funded by the GRDC and coordinated by Bill Gordon and conducted by the Hart Field-Site Group Inc (Peter Hooper and Roy Rogers), Mid North High Rainfall Zone group (Mick Faulkner and Jeff Braun), Peter Cousins and Allan Mayfield.

Introduction

The benefits of controlling summer weeds to conserve soil moisture and fertility are well proven and accepted within the broad acre cropping industry. However, the control of weeds over summer can be difficult to achieve given limited spraying opportunities, hard to kill weed species and plant stress. Also, increasing pressure from environmental groups, other land use sectors and the government in recent years have created the need for broad acre crop producers to establish summer spraying treatments and methodologies which also improves environmental safety.

Objectives

To measure the efficacy of coarser spray droplets on the control of two identified common summer weed species, and the influence of more adverse weather conditions.

Method

Two trial sites were selected, based on the prevalence of the targeted summer weed species: silver leaf nightshade (*solanum elaeagnifolium*)(SLN) and heliotrope (*heliotropium europaeum*)

A range of treatments were assessed including:

- herbicides – glyphosate (translocated) and Spray.Seed (contact)
- water rates – 60 or 90L/ha
- droplet size – medium through to alternating extra coarse

Treatments were applied to trial plots using a ute with boom mounted to one side.

Each trial was a randomised complete block design with four replicates and the plots were 2.5 x 20m.

The spraying details, treatments and conditions for each site are described below.

Visual assessments were made at 15 and 32 days after treatment for site 1, and 16 and 24 days after treatment at sites 2 and 3 using a weed control score of 0 – 100, where 100 = complete 'control' (stunting or desiccation), and 0 = no effect.

Site 1.

- *Site location and spraying date*: Clare, Mid-North of South Australia, Feb 1st, 2012
- *Site condition*: previously a long term pasture with little residue remaining
- *Target species*: silver leaf nightshade at various stages from young 10cm plants to mature 60-70cm plants at full flowering to early berry set stage, varying density, averaging approx 3 plants per square metre
- *Spraying conditions*: temp 18.5 – 22°C, humidity 27 - 22%, sunny, delta T of 9.75.
- *Herbicide treatment:* Roundup Attack (570g/L) 1.4L/ha + Amicide Advance (700g/L) 800ml + Uptake 0.5%
- *Nozzle and water rate treatments:* as per Table 1. Rain water was used as the carrier.

Table 1. Clare SLN trial details.

Droplet size	Water Rate (L/ha)	Nozzle type	Orifice size	Pressure	Speed (km/hr)
Nil	0				
Medium	60	Turbo Teejet	O2	3 bar	17
Coarse	60	Lechler	O2	3 bar	17
Extremely coarse	60	TTI	O2	3.5 bar	17
Twin Coarse	60	TTJ	O2	3 bar	17
Alternating extremely coarse	60	TTI	O2	3.5 bar	17
Nil	0				
Medium	90	Turbo Teejet	O3	4 bar	17
Coarse	90	AIXR	O25	4 bar	15
Extremely coarse	90	TTI	O15	4 bar	12
Twin Coarse	90	AITTJ	O25	4 bar	15
Alternating extremely coarse	90	TTI	O15	4 bar	12

Results

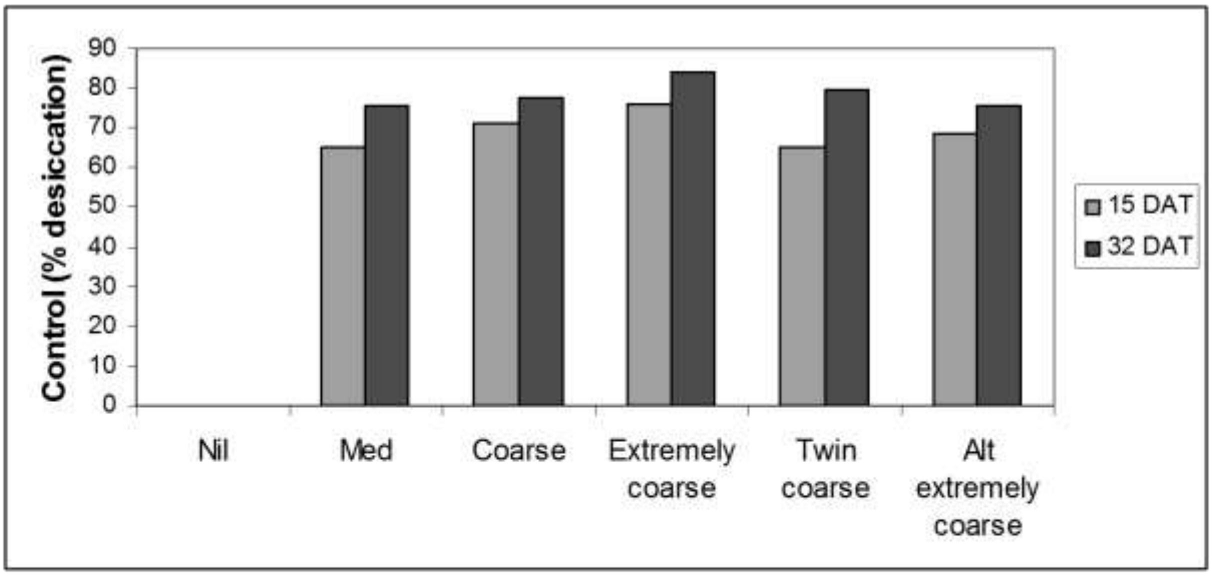
Site 1: Silver leaf nightshade at Clare

Assessment scores showed that the control of SLN progressed from 15 days after treatment (DAT) through to a maximum effect at day 32 DAT (Figure 1). The extremely coarse droplets gave the highest control at both assessment timings, however there were no significant differences in control between the various droplet sizes.

At 15 DAT the 90L/ha water rate (74.0%) had produced significantly greater control compared to the 60L/ha water rate (64.5%). However, by 32 DAT the average final results for the 90L/ha water rate (82.4%) were not statistically different to the 60L/ha rate (74.4%).

There were no interactions between water rate and droplet size.

Figure 1: Control (% desiccation) of silver leaf nightshade at 15 or 32 days after treatment using a range of droplet sizes for both water rates, using glyphosate and amicide at Clare 2012. LSD (0.05) for droplet size 12.5 at 15 DAT and 13.3 at 32 DAT.



Site 2.

- *Site location and spraying date:* Mintaro, Mid-North of South Australia, Feb 13th, 2012.
- *Site condition:* a bean stubble, with all residue laying on the ground
- *Target species:* heliotrope, 10-20cm high, flowering to seed set, variable density.
- *Spraying conditions:* temp 29.3 – 32.8^{o}C, humidity 13-16%, delta T of 14.5 - 15.5, wind speed average 7.7km/h, gusts to 16.5km/h, very warm afternoon
- *Herbicide treatment: (a) Power Max (540g/L) 1.2L/ha + Amicide Advance (700g/l) 800ml + Garlon 85ml/ha + ammonium sulphate 0.5% + LI700 0.2% (b) Spray.Seed 1L/ha*
- *Nozzle and water rate treatments:* as per Table 2. Rain water was used as the carrier.

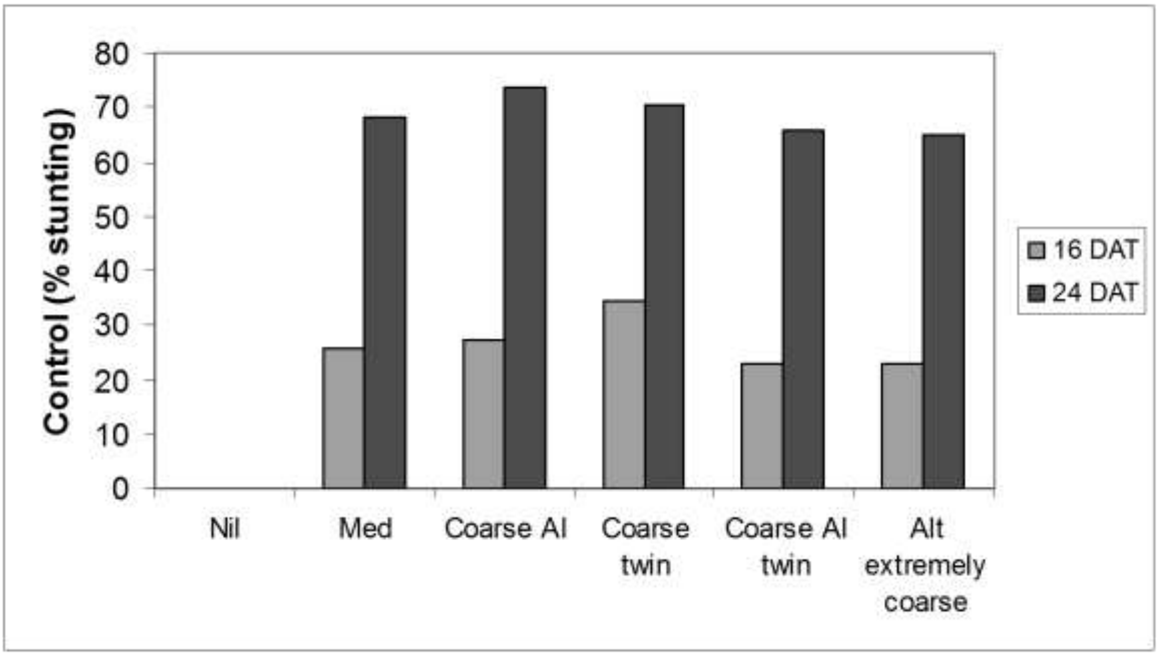
Table 2. Mintaro heliotrope trial details for glyphosate and SpraySeed.

Droplet size	**Water Rate (L/ha)**	**Nozzle type**	**Orifice size**	**Pressure**	**Speed (km/hr)**
Nil	0				
Medium	60	Turbo Teejet	O2	4 bar	18
Coarse air inducted	60	AIXR	O2	4 bar	18
Coarse twin	60	TTJ	O2	3 bar	16
Coarse air inducted twin	60	AITTJ	O2	4 bar	18
Alternating extremely coarse	60	TTI	O2	4 bar	18
Nil	0				
Medium	90	Turbo Teejet	O25	4 bar	15
Coarse air inducted	90	AIXR	O25	4 bar	15
Coarse twin	90	TTJ	O25	3 bar	15
Coarse air inducted twin	90	AITTJ	O25	4 bar	15
Alternating extremely coarse	90	TTI	O2	5 bar	14

Results

Site 2: Heliotrope at Mintaro, glyphosate treatments

Figure 2: Control (% stunting) of heliotrope at 16 or 24 days after treatment using a range of droplet sizes for both water rates, using a glyphosate mix at Mintaro 2012. LSD (0.05) for droplet size 8.3 at 16 DAT and 11.5 at 24 DAT.



Assessment scores for the glyphosate mix at 16 DAT were all under 35% control, but by the final assessment at 24 DAT all treatments were above 65% (Figure 2). At 16 DAT the coarse air inducted (34.4%) treatment had produced significantly greater control. However, 8 days later there was no significant difference between the droplet size treatments, although the coarse air inducted treatment was still the best at 73.8%.

There was no significant difference between water rates.

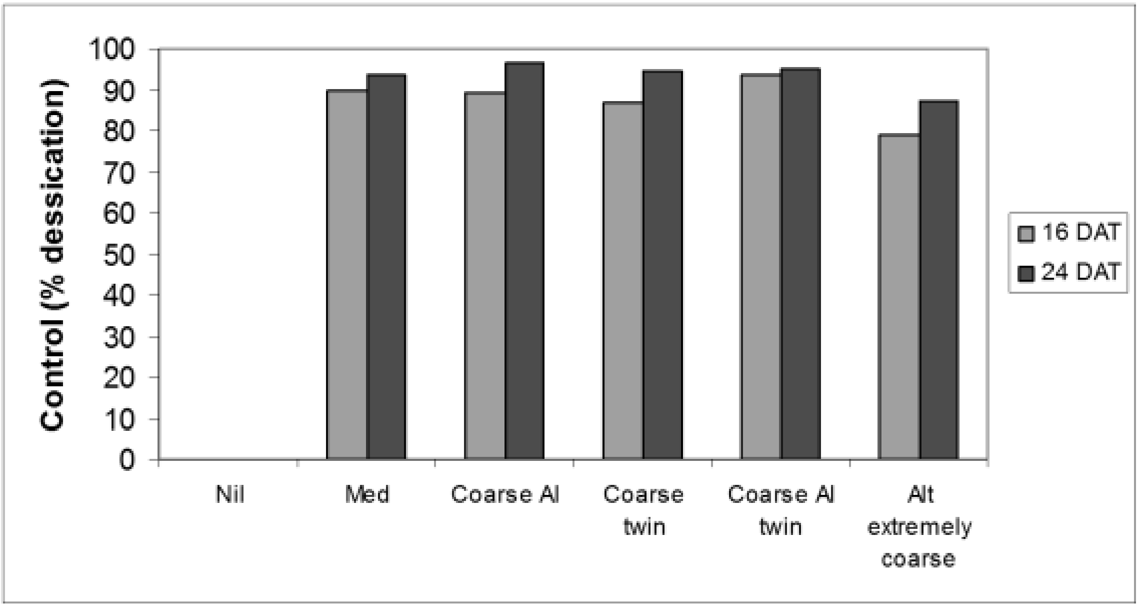
Results

Site 2: Heliotrope at Mintaro, Spray.Seed treatments

At 10 DAT all treatments had over 70% control and by 24 DAT maximum control was 98% (Figure 3). At both assessment timings the alternating extremely coarse treatment produced significantly lower control of heliotrope. Control was improved at the higher water rate to 92%, but was still below the other treatments.

There was no significant difference between the other droplet sizes or water rates.

Figure 3: Control (% dessication) of heliotrope at 16 or 24 days after treatment using a range of droplet sizes for both water rates, using Spray.Seed at Mintaro 2012. LSD (0.05) for droplet size 8.6 at 16 DAT and 5.9 at 24 DAT.



Conclusions

Trials conducted in 2012 have shown that larger droplets and variations in droplet application direction can successfully control summer weeds, compared to the traditionally favoured medium droplets.

This includes a variation of weed species, different herbicides types and application within conditions that are not generally conducive to summer spraying.

The work has shown that for contact herbicides like Spray.Seed extremely coarse droplets can give reduced control, regardless of water rate.

Acknowledgements

Many thanks are extended to Nick Ashby, Allen Kelly and Andrew Hawker for the use of their land and cooperation with this trial work.

Appendix – actual data from sites 1, 2 and 3

Table 3. Control (% desiccation) of silver leaf nightshade at 15 or 32 days after treatment using a range of droplet sizes for both water rates, using glyphosate and amicide at Clare 2012.

Droplet size	Water rate (L/ha)	% desiccation 15 DAT	% desiccation 32 DAT
Nil	60	0	0
Medium		61.2	67.5
Coarse		63.8	73.8
Extra Coarse		70.0	76.2
Twin Coarse		58.7	82.5
Alternating extremely coarse		68.8	72.0
Nil	90	0.0	0.0
Medium		68.8	83.2
Coarse		78.8	81.2
Extra Coarse		82.5	92.0
Twin Coarse		71.2	77.0
Alternating extremely coarse		68.8	78.8
LSD (0.05)			
Droplet		12.5	13.3
Water rate		7.2	ns
Droplet * water rate		ns	ns

Table 4. Control (% dessication or stunting) of heliotrope at 16 or 24 days after treatment using a range of droplet sizes for both water rates, using Spray.Seed at Mintaro 2012.

Droplet size	Water rate (L/ha)	Spray.Seed % desiccation		Glyphosate % stunting	
		16 DAT	24 DAT	16 DAT	24 DAT
Nil	60	0.0	0.0	0.0	0.0
Medium		87.5	92.5	27.5	72.5
Coarse air inducted		88.8	98.0	30.0	78.8
Coarse twin nozzle		88.8	94.0	30.0	68.8
Coarse air inducted twin		92.5	93.8	27.5	70.0
Alternating extremely coarse		72.5	82.5	25.0	63.8
Nil	90	0.0	0.0	0.0	0.0
Medium		92.0	94.5	23.8	63.8
Coarse air inducted		89.5	95.5	25.0	68.8
Coarse twin nozzle		85.0	95.5	38.8	72.5
Coarse air inducted twin		94.8	96.8	18.8	61.2
Alternating extremely coarse		86.0	92.3	21.2	66.2
LSD (0.05)					
Droplet		8.6	5.9	8.3	11.5
Water rate		ns	ns	ns	ns
Droplet * water rate		ns	ns	ns	ns

Bacterial blight in field pea

Jenny Davidson; SARDI, Tony Leonforte; (DPI Vic), Peter Hooper; Hart Field-Site Group, Simon Honner; Cox Rural

Key findings

Prevention of bacterial blight (BB):

- In frost prone areas, sow field pea varieties that have some resistance against BB
- Use seed that was harvested from a crop that was free of BB
- Do not apply herbicides to the crop if there is a risk of frost as this can increase the risk of BB

If bacterial blight infects a crop:

- Do not drive over the paddock as bacteria will spread on wheels of vehicle
- Harvest the infected pea crop after uninfected crops, to prevent spread of bacteria through the harvester to other pea seed
- Do not spread stubble or hay from the infected crop to other paddocks as bacteria will survive in the stubble
- Do not keep pea seed for next years' crop
- No sprays or seed dressings can control BB effectively

What is it?

This disease is very sporadic and often unpredictable. It is caused by the bacterium *Pseudomonas syringae* consisting of two pathovars (pv), *P. syringae* pv *pisi* and *P. syringae* pv *syringae*. Frost damage followed by wind and frequent rain encourages the development and spread of the disease. This highly infectious disease can be easily spread by movement through the crop of machinery, people and animals.

How does it spread and how can we reduce the risk?

P. syringae survives on both seed and infected plant material and these two sources are the main means of transmission of the disease to new crops. Therefore, seed harvested from infected crops should not be used for sowing. Infected crops should be harvested last of all pea crops on the property, to prevent infected stubble in the harvester moving over the property and to prevent small pieces of infected stubble remaining in the header and infecting other pea seed. Likewise, movement of pea stubble from these crops should be closely monitored, particularly when baled for hay as this is a ready source of infective bacteria. Also be aware that crops having no obvious signs of disease may still carry the bacteria at low levels.

Bacterial blight will often develop in frost prone, low lying areas first. Be aware that frost events can trigger development of this disease and check these areas first for symptoms. Avoid sowing field pea crops in paddocks prone to frequent frost events.

Operations favouring rapid breakdown of pea trash can greatly reduce the length of survival of the bacterium. Control of volunteer pea plants is equally important for control of this disease between seasons. Survival can be up to three years on seed in storage.

Which varieties have better tolerance?

Field pea variety screening for bacterial blight is regularly undertaken at Wagga Wagga in NSW for the Pulse Breeding Australia – Field Pea Breeding Program. The varieties PBA Oura and PBA Percy were released in October 2011 with significantly improved resistance to *Pseudomonas* *syringae pv syringae*. In the older varieties, Morgan, Parafield, Sturt and Yarrum display the best field tolerance.

Field pea varietal resistance categories for bacterial blight

Variety	Bacterial blight
PBA Percy	MR
PBA Hayman* (*Forage type)	MR
PBA Oura	MS-MR
Morgan	MS
Parafield	MS
PBA Pearl	MS
Sturt	MS
Kaspa	S
PBA Gunyah	S
PBA Twilight	S
Excell	S
Maki	S
SW Celine	S
Walana	S
Yarrum	S

Where was it seen locally in 2012?

In 2012 agronomists first reported bacterial blight on field peas in late September near Hart, Burra and Jamestown in PBA Oura, PBA Percy and Kaspa crops; in some cases with large patches in the paddock. Both PBA Oura and PBA Percy can develop symptoms as patches but the disease does not spread as much as in Kaspa.

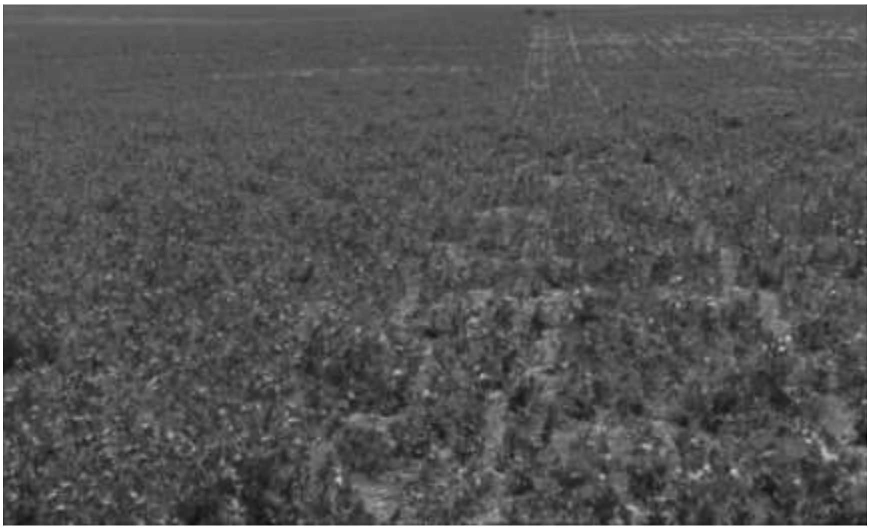
Agronomists observed a crop of PBA Oura peas near Black Springs planted next to Kaspa and both were very badly affected in late September. Most of the PBA Oura plants had disease symptoms, and there were patches within the crop the size of a card table where the peas were only 6 inches high. Initially it was very difficult to see any difference in disease levels between the two crops but a couple of weeks later the PBA Oura peas had 'grown away' from the disease compared to the Kaspa. Another infected crop of Kaspa in the Jamestown region was adjacent to PBA Percy. The Kaspa was not reaped, while Percy lost about 30% of yield. It is possible that the proximity to the diseased Kaspa crop increased the level of infection in the crop of PBA Percy.

Plant samples from these crops were sent to DPI Vic and *Pseudomonas syringae* pv *syringae* was isolated; this was consistent with the Victorian bacterial blight samples in 2012.

In one of the crops agronomists noted the timing of the appearance of bacterial blight followed a grass herbicide application. The herbicide applications could be implicated through damage of the crop by running over plants. This would lead to bacterial blight hotspots appearing in wheel tracks. Alternatively a wetter may prolong droplet formation on leaves and stems, which may interact with frost events and exacerbate freezing injury.

Reference

Armstrong et al (2012) Field Pea Disease Guide in NSW Winter Crop Variety sowing guide, pp90-98.



Bacterial blight in Kaspa peas (right) and PBA Oura (left).

Bacterial blight in Kaspa peas (Left) and PBA Percy (Right)

Effects of fluid fungicides on crown rot when applied at sowing

Margaret Evans and Hugh Wallwork – SARDI. Funding - GRDC (DAS00099) and industry partners

Key findings

- Evidence from this trial indicates that further investigation of fluid fungicides banded at sowing for crown rot management is warranted
- Many treatments decreased crown rot incidence early in the season and in these treatments, the plants had increased vegetative bulk later in the season
- Fungicide application reduced levels of crown rot DNA in the crop at maturity
- Expression of crown rot symptoms in durum wheat and bread wheat were different, depending on the treatment applied

Why do the trial?

This was a proof-of-concept trial to assess whether applying fluid fungicides in bands at sowing has potential for managing crown rot.

How was it done?

Funding from GRDC and industry partners was used to run the trial, which was direct drilled on 12th June 2012 in plots of 6 rows x 14m. In each plot, the fungicide treatment was applied to 3 rows, with 3 rows left untreated. Three replicates were sown to the bread wheat cultivar "Yitpi" and three replicates were sown to the durum wheat cultivar "Tamaroi". Three fungicides with different chemistries were applied as fluids in the following locations:

- IF - in furrow as a band below the seed.
- SB - as a band on the soil surface above the seed.
- IF+SB - half rate of the fungicide applied IF and half rate applied SB.

Samples for visual disease assessment and pathogen DNA analysis were taken in August at early tillering and in October at early grain fill. Harvest index cuts were taken in November (harvest ready) as plots were not suited to standard harvesting methods.

Browning on the base of the leaf sheath (August samples) or stems (October samples) was used to assess incidence of crown rot (% of plants showing basal browning). Crown rot severity (scoring scale 0-5 on the main stem) and whitehead expression were recorded for October samples. After visual disease assessments, the base 7 cm of the plant was dried and ground, then sent to the Predicta B testing service at SARDI to assay for DNA of *F. pseudograminearum*.

Results

Figure 1. Effect of fungicides applied at sowing on crown rot incidence at early tillering in durum and bread wheats

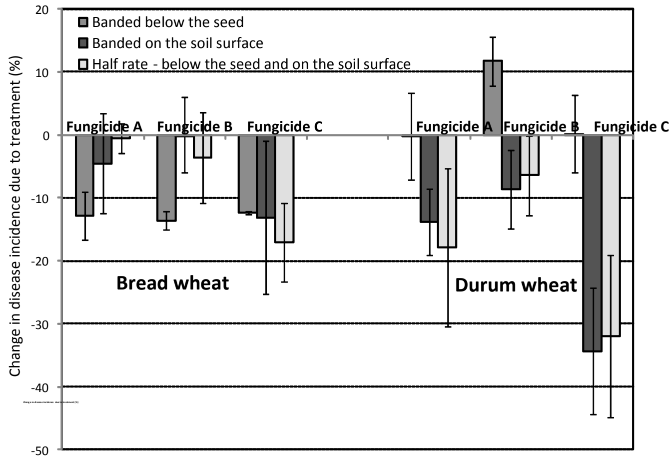


Figure 2. Effect of fungicides applied at sowing on vegetative plant weight at maturity in durum and bread wheats

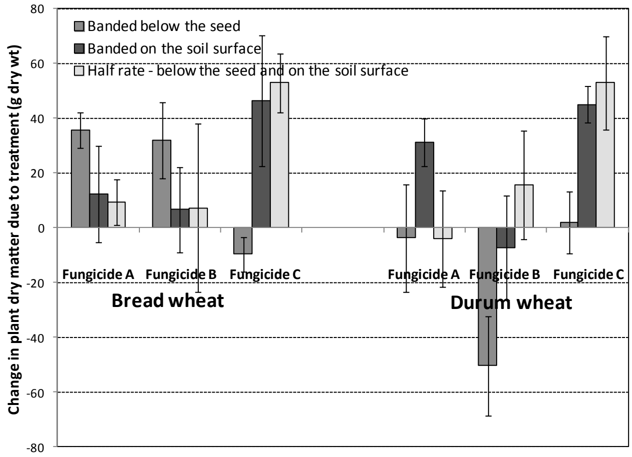
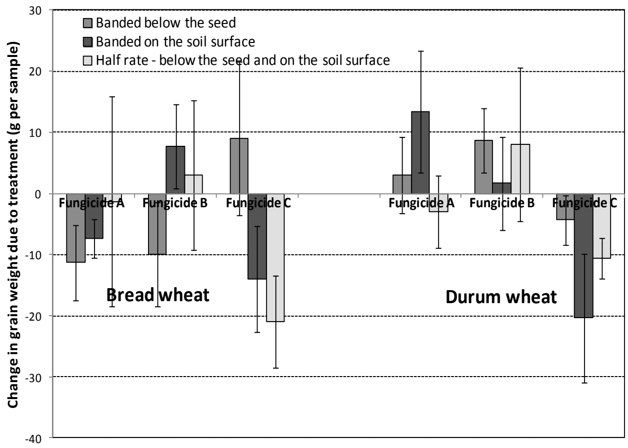


Figure 3. Effect of fungicides applied at sowing on grain weight at maturity in durum and bread wheats



The information presented in these graphs is a subset of that which is available and has been chosen to illustrate the main findings from the trial.

Graphs show the difference between results from untreated and fungicide treated areas within each trial plot. Standard errors of the mean are presented on each histogram bar.

Fig. 1 shows that crown rot incidence is reduced by many of the fungicide treatments. Banded below the seed appears most effective for bread wheat and banded on the surface appears most effective for durum wheat.

Fig. 2 shows that where fungicide application reduced disease incidence, that vegetative crop bulk at maturity was generally increased.

Fig. 3 shows that fungicide treatments which reduced disease incidence and increased vegetative crop growth generally had the lowest grain yield per sample.

At anthesis, concentrations of pathogen DNA in the crop were reduced by up to 99% (mean of 76% ± 3%) by fungicide application. This level of reduction occurred for both bread and durum wheat.

Discussion

Fungicide application as fluid bands at sowing reduced concentrations of the crown rot pathogen in plant tissues. This was associated with a reduction in disease expression in young plants and improved crop growth after that. This is the first record of one fungicide application having a visible effect on the crown rot pathogen, disease expression and plant growth in cereals.

The effectiveness of fungicide application did not result in improved yields. In fact, the more effective the fungicide was early in the crop, the lower the yields. This might be the result of greater crop bulk in those treatments resulting in more moisture stress during the very low rainfall spring of 2012. This outcome is likely to be a rare event. In most instances a reduction in crown rot is expected to lead to increased yields.

Bread and durum wheat appeared to respond differently to the placement of fungicides and it is unclear why this effect occurred or whether it would be repeatable. What is clear is that for both cereal types, fungicide application reduced pathogen DNA concentrations at maturity and this implies there will be less carryover of crown rot inoculum to the next crop. The practical outcomes from this reduction need to be explored as fluid fungicide banding may contribute significantly to keeping crown rot inoculum at a low risk level. This might be a powerful management tool, particularly in inter-row sowing systems.

Further trial work will be required to confirm the effects seen in this trial and to explore the reliability with which these effects express over a range of sites and seasons. More importantly, the cost-effectiveness of such treatments needs to be established.

Harvest at Hart 2012

Improving water use efficiency – reducing soil evaporation

This trial is funded by the GRDC and conducted in collaboration with Chris Lawson and Victor Sadras, SARDI, and Glenn McDonald from the University of Adelaide.

Key findings

- The addition of a straw layer acted to reduce evaporation and significantly increased grain yields and water use efficiency in 2012, at 4 field sites
- Soil evaporation also decreased with increasing light interception from larger crop canopies

Why do the trial?

Throughout southern Australia many trials have recently focussed on improving the retention of summer rainfall and have clearly shown that effective and early summer weed control increases stored soil moisture. Soil cover i.e stubble, throughout the summer period was shown to provide limited additional benefit.

This trial aimed to use a thick layer of cereal straw maintained within the growing season to focus on reducing the amount of moisture lost to soil evaporation. The trials were conducted on the previously established sites used in improving water use efficiency trials.

How was it done?

Plot size 8m x 10m

Seeding date	Hart 30th May 2012	**Fertiliser**	Hart	DAP @ 80kg/ha + 2% Zn
	Condowie 21st May		Condowie	DAP @ 65kg/ha + 2% Zn
	Spalding 17th May		Spalding	DAP @ 80kg/ha + 2% Zn
	Saddleworth 18th May		Saddleworth	DAP @ 100kg/ha + 2% Zn

Post emergent nitrogen:

The Hart site received 40kg N/ha on the 24th July and the other sites on the 13th August.

The extra nitrogen treatments received an extra 46kg N/ha on the 13th of August.

Each trial was a randomised complete block design with 3 replicates using Gladius wheat sown onto Gladius wheat.

The trials were sown into plots where in 2011 part of the plot was spread evenly with 6t/ha of oaten straw immediately after sowing. This straw layer provided about 95% soil cover. This straw layer had remained intact throughout the 2011 growing season, summer of 2011/2012 and autumn of 2012.

After sowing in 2012, half of the plot that was covered in 2011 was re-spread with 6t/ha oaten straw and the other half was raked clear of straw. In addition, 6t/ha oaten straw was spread onto half of the plot sown in 2012, which had no straw in 2011.

The trials were sown with 50mm chisel points and press wheels on 225mm (9") row spacing. The soil was sampled down to 90cm for soil moisture on the 18th of May and averaged for 3 replicates.

All cereal grain plots were assessed for grain yield, protein, wheat screenings with a 2.0mm screen and barley screenings with a 2.2mm screen and retention with a 2.5mm screen.

Table 1. Pre-sowing total soil moisture (mm) down to 90cm at each site.

Site	Straw	0-20cm	20-50cm	50-90cm	Total
Condowie	Straw	25.6	45.6	75.0	146.2
	No straw	20.9	41.3	66.6	128.8
Hart	Straw	32.2	51.7	76.5	160.4
	No straw	34.6	51.4	78.1	164.1
Saddleworth	Straw	56.0	76.4	113.5	245.9
	No straw	54.2	84.7	94.4	233.3
Spalding	Straw	31.4	59.3	60.2	150.9
	No straw	28.5	53.5	53.1	135.1

Results

All the trials were dry sown in 2012 and combined with the varying layers of straw meant that crop emergence was highly variable and sometimes reduced in the straw plots. Higher weed burden in some of the straw plots also contributed to the variability in grain yields.

Pre-sowing soil moisture sampling between the plots covered with straw since sowing in 2011 and those with no extra straw have shown about a 15mm increase in soil moisture, down to 90cm. This ranged from 12mm at Saddleworth to 17mm at Condowie.

Across the four regional sites grain yields ranged from 1.66t/ha at Hart and Condowie up to 4.60t/ha at Saddleworth. At three of the sites the straw cover present from sowing in 2011 through to harvest in 2012 gave an increase in grain yield (Table 1). Compared to no extra straw this increase was 14% at Hart, 30% at Condowie and 43% at Spalding.

Table 1. Wheat grain yield for straw treatments applied at Condowie, Hart, Saddleworth and Spalding in either 2011 and / or *2012.*

Treatment		Hart	Saddleworth	Condowie	Spalding
Straw 2011	**Straw 2012**				
0	0	1.78	4.44	1.66	2.12
Yes	0	1.66	5.22	2.73	2.37
Yes	Yes	2.08	4.60	2.35	3.76
0	Yes	1.86	4.59	2.10	3.13
LSD (0.05)	Straw in 2011	ns	ns	0.4	ns
	Straw in 2012	ns	ns	ns	0.8
	Straw in both years	ns	ns	0.6	ns

At Condowie and Saddleworth the straw applied in 2011 and removed at sowing 2012 produced the greatest increase in yield compared to no straw, 39% and 15% respectively. This might be explained by the ability of these sites to store some of the above average rainfall from the 2011 harvest and summer.

Conversely, at Spalding the greatest influence on grain yield came from the straw applied in 2012 only, increasing grain yield by 32% compared to no straw.

The results from this trial work suggest that a thick layer of straw over summer can have a significant impact on subsequent grain yields. Logically, reducing the amount of sunlight hitting a soil surface, for instance by adding a layer of straw, will decrease the amount of moisture lost from soil evaporation. Figure 3 shows how the developing crop canopy at each of the sites was also able to reduce soil evaporation. As more light was intercepted by the crop canopies the proportion of water lost through soil evaporation decreased, thus leaving more water available for crop transpiration or growth.

Generating this sort of soil cover would be unrealistic in most paddocks and so future research will look at the benefits of standing stubble.

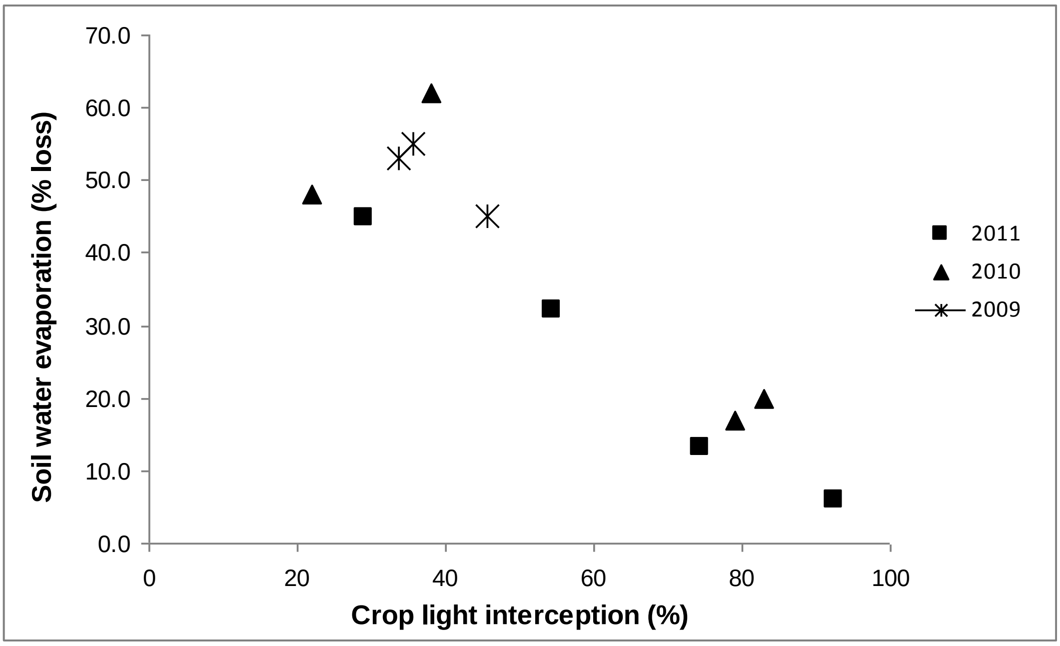


Figure 3: The percentage of total crop available water evaporated from the soil and the amount of light intercepted by the crop canopy during stem elongation at three sites in 2009 and 2010, and four sites in 2011.

Acknowledgements

The Hart Field-Site Group wish to thank Brian Kirchner and Simon Goldsmith, Andrew and Rowan Cootes, Michael and David Miller, David Hentschke and Matt Ashby for the use of their paddocks and cooperation with this trial work.

Managing crop growth and water use

This trial is funded by the GRDC and conducted in collaboration with Victor Sadras, SARDI, and Glenn McDonald from the University of Adelaide.

Key findings

- The highest yielding treatments were the early high nitrogen rate (2.80t/ha) or the high nitrogen rate (2.91t/ha)
- Treatments imposed to manipulate crop growth were unable to save more soil moisture for grain fill

Why do the trial?

Throughout southern Australia many trials have recently focussed on improving the retention of summer rainfall and have clearly shown that effective and early summer weed control can increase the retention of stored soil moisture. Previous research conducted at the Hart field site in 2009 and 2010 showed that soil cover i.e stubble, provided limited additional benefit.

The research also showed that additional stored moisture was more likely to be used early in the season to increase crop growth, rather than contributing towards grain fill.

The above average rainfall and cool summer conditions of 2011 built up a significant amount of stored soil moisture (40 to 60mm in many areas). This trial aimed to manage the crop canopy and conserve the stored soil moisture so that it might be saved for grain-fill, rather than being used to create early crop growth.

How was it done?

Plot size	1.4m x 10m	**Fertiliser**	DAP + Zn 2% @ 80kg/ha
Seeding date	30th May 2012	**Varieties**	Gladius wheat @ 100kg/ha

The trial was a randomised block design with 10 treatments and 3 replicates (Table 1). The seeding equipment used was a knife-point press wheel system on 22.5cm (9") row spacings. The narrow row treatments were 11cm (4.5") row spacings and were made by sowing twice along the plot and using auto-steer to sow in between the previous sowing rows.

Table 1. Treatments and nitrogen fertiliser rates and timings for managing crop growth and water use at Hart in 2012.

Treatment	Nitrogen fertiliser (kg N/ha) timing			
	Sowing	24th July (GS31)	23rd August (GS33)	Total
Early variety - Axe	14	34	0	48
Mid variety - Mace	14	34	0	48
Late variety - Pugsley	14	34	0	48
Reduced seeding rate - 20% lower	14	34	0	48
Narrow row spacing	14	34	0	48
Growth regulant at GS30	14	34	0	48
Early high N	94	34	0	128
Split N	14	34	23	71
High N rate	14	80	46	140

42kg N/ha was applied to all treatments at 1st node (GS31) and 1 L/ha of chlormequat with 200ml/ha Moddus Evo plant growth regulator was applied at the beginning of stem elongation (GS30) to the growth regulant treatment.

Plant counts and head counts were conducted during the season and all plots were assessed for grain yield, protein, wheat screenings with a 2.0mm screen and barley screenings with a 2.2mm screen and retention with a 2.5mm screen.

Pre-sowing plant available soil moisture was 44mm to a depth of 90cm and soil nitrogen was 65kg N/ha.

Results

Plant numbers were 114 plants per square metre, with little difference between the treatments. The reduced seeding rate treatment had 100 plants per square metre. There was also no difference between treatments for head number, with the trial average being 253 heads per square metre.

The highest yielding treatments were the early high nitrogen rate (2.80t/ha) or the high nitrogen rate (2.91t/ha) (Table 2). Other treatments which performed well included Mace wheat (2.77t/ha) and the narrow row spacing treatment (2.76t/ha). The later maturing variety Pugsley was the lowest yielding variety (2.28t/ha), which is understandable given the quick finish to the season.

Grain protein was variable and generally lower with higher grain yields and later applications of nitrogen. There was little difference between treatments for test weight and screenings.

The wet 2011 harvest and 2012 summer provided an opportunity to reduce early crop growth and to conserve moisture for grain fill. None of the treatments used to manipulate the crop canopy positively influenced crop growth or grain yield.

Table 2. Grain yield and quality and resultant heads per square metre for canopy management treatments at Hart in 2012.

Treatment	Grain yield (t/ha)	Protein (%)	Test weight (kg/hL)	Screenings (%)	Head number (heads per sq m)
Early variety - Axe	2.39	13.1	78.7	0.4	243
Mid variety - Mace	2.77	11.0	79.4	0.7	298
Late variety - Puglsey	2.37	12.7	79.3	0.6	280
Reduced seed rate	2.62	10.9	80.1	0.7	224
Narrow row spacing	2.76	12.1	79.0	0.9	277
Growth regulant at GS30	2.58	11.1	79.4	0.6	247
Early high N	2.80	12.1	79.8	0.8	200
Split N	2.65	11.7	79.4	0.7	252
Late high N	2.72	10.9	79.7	0.6	243
High N rate	2.91	11.8	79.3	0.7	265
LSD (0.05)	0.14	0.86	0.35	ns	ns

Improved yield of wheat: changes in crop physiology and implications for agronomy

Funded by the GRDC Water Use Efficiency Initiative. Conducted by Victor Sadras and Chris Lawson, SARDI

Key findings

- Modern wheat varieties have a higher demand for nitrogen and agronomic practices need to take this into account
- The most critical period for setting grain yield potential is between stem elongation (GS31) and flowering
- Current varieties are well beyond the potential 20kg grain/ha per mm water benchmark. This needs to be updated to 24kg grain/ha per mm water

Why do the trial?

Wheat breeders select primarily for grain yield whilst trying to maintain or improve agronomic performance, grain quality and disease tolerance. In selecting for yield, crop traits can change; some of these changes have agronomic implications. In these trials we asked:

- What are the main changes in crop traits behind yield improvement?
- Are there agronomic practices that need to be adjusted to account for these changes?

How was it done?

Trials were established to compare 13 wheat varieties released between 1957 and 2007: Heron (1958), Gamenya (1960), Halberd (1969), Condor (1973), Warigal (1978), Spear (1984), Machete (1985), Janz (1989), Frame (1994), Krichauff (1997), Yitpi (1999), Wyalkatchem (2001), and Gladius (2007).

These trials were sown at Hart, Roseworthy and Turretfield in 2010, and Hart and Roseworthy in 2012. In 2012, crops were grown under low and high nitrogen rates.

We measured yield and growth (grain number, head number, grains per head, 1000 seed weight), biomass and harvest index. We also measured crop photosynthesis, and water use and nitrogen uptake. Water use efficiency and nitrogen use efficiency were calculated.

Results

There was a sustained yield improvement in wheat varieties released between 1957 and 2007. After accounting for differences in background environment and yield potential, the rate of improvement of Australian breeding was similar to the rate reported for overseas breeding programs. Australian wheat breeders are doing a world-class job.

<u>Harvest index</u>

There was a sustained increase in harvest index between the 1957 and 2007 varieties. During this period the proportion of biomass in the grain increased by approximately 8%, contributing substantially to the higher yield of current varieties.

Crop water use

Crop water use did not change significantly between the 1957 and 2007 varieties. Wheat varieties have increased yield under the same water uptake, hence water use efficiency has improved. The major advances in breeding have come through improved harvest index and biomass production rather than improved water uptake. Halberd wheat, a variety typical of the 1970s, had a potential of 20kg/ha per mm of growing season rainfall whereas current varieties can reach 24kg/ha per mm (see Figure 1). Growers and advisors need to update their water use efficiency benchmark to account for current varieties.

Photosynthesis

There was a sustained increase in pre-flowering crop photosynthesis between varieties released in 1957 and 2007. This has been proven to be an important driver of improved yield. Enhanced photosynthesis was related to changes in canopy architecture, i.e. shorter varieties, better leaf angle and better distribution of light in the canopy. Leaves at the bottom of the canopy are also greener in newer varieties. To capture the improved photosynthesis of modern varieties, nitrogen fertilisation is critical to maintain a green canopy, particularly between stem elongation and flowering.

Nitrogen uptake

There was a significant increase in nitrogen uptake with later variety releases. Modern varieties take up to 40 kg/ha more nitrogen than older varieties. A “mining” effect is likely over the long term if fertilisation practices and management of soil fertility do not account for the enhanced nitrogen uptake of new varieties. There is also a risk of declining protein in grains unless nitrogen rates are adjusted accordingly.

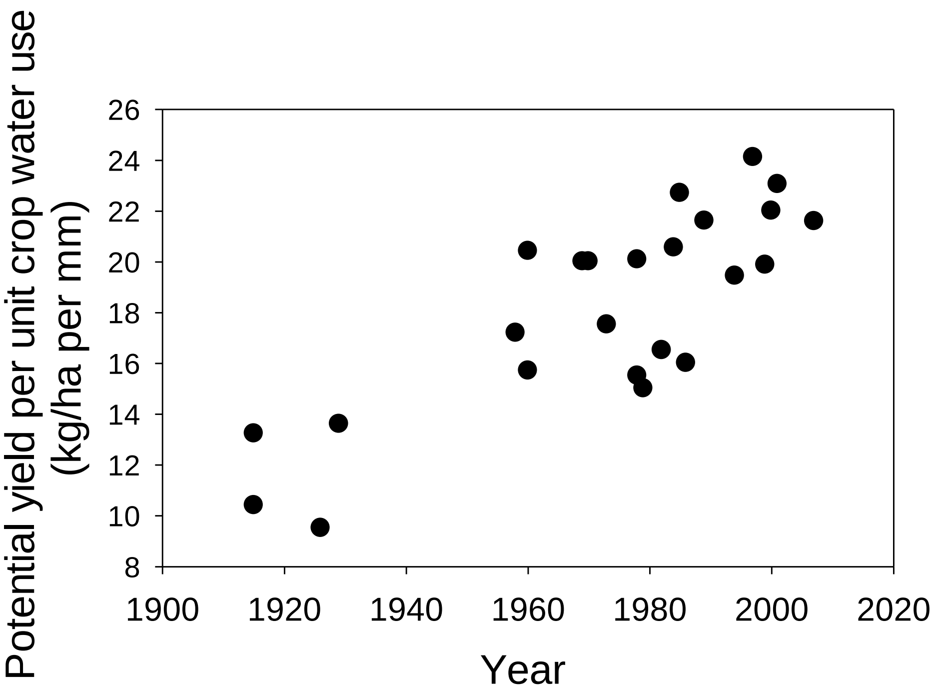


Figure 2: Progress in water use efficiency during a century of breeding for wheat yield in Australia.

Improving water use efficiency – crop rotations

This trial is funded by the GRDC and conducted in collaboration with Chris Lawson and Victor Sadras, SARDI, and Glenn McDonald from the University of Adelaide.

Key findings

- At three out of the 4 sites gladius wheat sown onto a pea crop background from 2011 produced the best grain yields
- At Condowie wheat on barley (2.54t/ha average) was always better than wheat on wheat (2.10t/ha average), regardless of extra nitrogen

Why do the trial?

Throughout southern Australia traditional crop rotations are based on wheat following an oilseed or legume break crop and then followed by either wheat or barley. Generally wheat following barley is generally avoided to minimise the chances of grain contamination and downgrading at harvest, and the build up of weeds.

These trials aimed to assess the performance of wheat following either peas, wheat or barley. The trials were conducted on the previously established sites used in improving water use efficiency trials.

How was it done?

Plot size	8m x 10m			
Seeding date	Hart 30th May 2012	**Fertiliser**	Hart	DAP @ 80kg/ha + 2% Zn
	Condowie 21st May		Condowie	DAP @ 65kg/ha + 2% Zn
	Spalding 17th May		Spalding	DAP @ 80kg/ha + 2% Zn
	Saddleworth 18th May		Saddleworth	DAP @ 100kg/ha + 2% Zn

Post emergent nitrogen:

The Hart site received 40kg N/ha on the 24th July and the other sites on the 13th August.

The extra nitrogen treatments received an extra 46kg N/ha on the 13th of August.

Each trial was a randomised complete block design with 3 replicates using Gladius wheat sown onto either kaspa pea, gladius wheat or commander barley stubble from 2011.

The trials were sown with 50mm chisel points and press wheels on 225mm (9”) row spacing.

All cereal grain plots were assessed for grain yield, protein, wheat screenings with a 2.0mm screen and barley screenings with a 2.2mm screen and retention with a 2.5mm screen.

Results

At three out of the 4 sites gladius wheat sown onto a pea crop background from 2011 produced the best grain yields. This result is well understood and expected due to benefits from disease control, fewer weeds, more moisture and high soil nitrogen. At the Saddleworth site, which averaged 4.53t/ha, the previous crop made no significant difference to the wheat yield in 2011.

With no extra applied nitrogen the next best previous crop choice was barley, for all the sites except Hart (Table 1). Wheat after wheat was generally the lower yielding treatment. This might be due to root and leaf diseases i.e yellow leaf spot, which can carry over from year to year on the same crop types, or a soil moisture effect.

However, when extra nitrogen was applied on the 14th of August, the wheat on wheat yields improved and matched the wheat on barley yields, at 3 of the sites. At Condowie wheat on barley (2.54t/ha average) was always better than wheat on wheat (2.10t/ha average), regardless of extra nitrogen.

Protein generally increased with nitrogen from 10.5% with standard nitrogen to 11.3% with extra nitrogen across all the trials and treatments. The protein levels at Saddleworth were very low, averaging only 7.1%.

Table 1. Wheat grain yield for rotation and nitrogen treatments applied at Condowie, Hart, Saddleworth and Spalding in 2012.

Site	Previous crop	Nitrogen (kg N/ha)	Grain yield (t/ha)	Protein (%)
Hart	Wheat	0	2.32	12.3
		50	2.32	12.6
	Barley	0	2.09	11.2
		50	2.24	11.9
	Peas	0	2.76	11.9
		50	2.90	12.5
LSD (0.05) Prev crop, nitrogen, crop*nitrogen			0.3, ns, ns	0.6, 0.5, ns
Saddleworth	Wheat	0	4.12	7.2
		50	4.89	8.8
	Barley	0	4.26	5.5
		50	5.04	6.4
	Peas	0	4.10	6.4
		50	4.77	8.0
LSD (0.05)			ns, 0.6, ns	1.2, 1.0, ns
Condowie	Wheat	0	2.20	11.8
		50	1.99	12.4
	Barley	0	2.55	9.9
		50	2.54	11.0
	Peas	0	2.57	10.8
		50	2.77	10.7
LSD (0.05)			0.4, ns, ns	0.6, 0.5, ns
Spalding	Wheat	0	2.77	13.7
		50	3.02	14.3
	Barley	0	3.08	11.5
		50	3.06	12.5
	Peas	0	3.17	13.7
		50	3.48	14.5
LSD (0.05)			0.3, ns, ns	0.9, 0.7, ns

Using wheat after wheat as a reference the values in Figure 1 show the grain yields for wheat after barley to have a slight benefit in lower yielding environments. Figure 2 shows that wheat following peas generally outyielded wheat after wheat and again the differences were larger in lower yielding environments. When the location reached over 4t/ha, the benefit of a pea history disappeared.

These trial results have shown that the sequence of crop rotations could have an impact on water use efficiency. Advances to farming systems such as Group B tolerant crops, Harrington seed destructors or chaff carts mean that flexibility over traditional rotations is now possible, and can offer benefits.

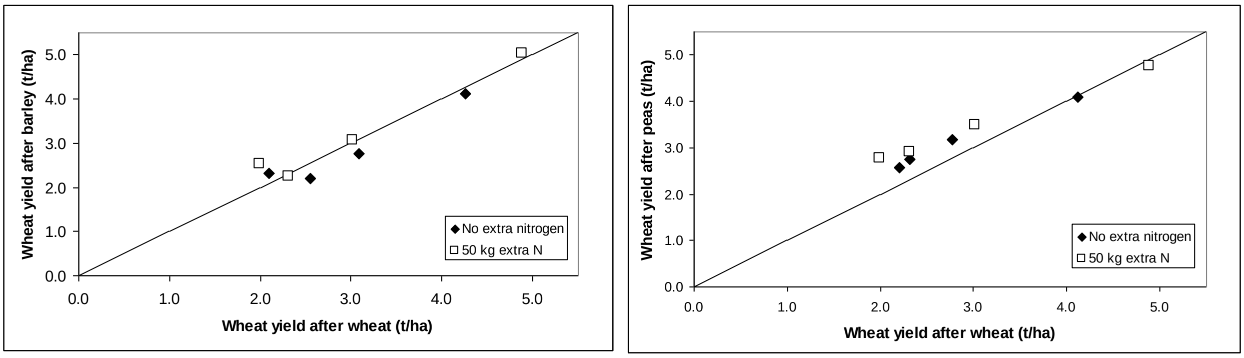


Figure 1 & 2: Wheat grain yield following barley or peas with or without extra nitrogen at Condowie, Hart, Saddleworth and Spalding in 2012. The black line is the 1:1 comparison.

Acknowledgements

The Hart Field-Site Group wish to thank Brian Kirchner and Simon Goldsmith, Andrew and Rowan Cootes, Michael and David Miller, David Hentschke and Matt Ashby for the use of their paddocks and cooperation with this trial work.

Hart Field Day, 2012

Where has your HART HAT been?

Send us a photo of:

- *you wearing your **Hart hat** somewhere far away, interesting, funny or unusual*
- *someone famous wearing your **Hart hat***

*and you'll be in the running to win a **Hart Gold Membership**!*

Gary & Ros Zweck won last year's competition with this winning photo taken in the Bavarian Alps, Germany.

Here's some of last year's entries!

Cropping systems

Funded by Caring for Our Country and conducted in collaboration with farmers Michael Jaeschke and Matt Dare, South Australian No Till Association, and Rocky River Ag.

Key findings

- The no-till treatment yielded the highest again (1.11t/ha), followed by the disc (1.05t/ha) and strategic (0.92t/ha)
- The high nutrition treatments had accumulated 45kg N/ha more soil available nitrogen compared to the medium treatments to a depth of 60cm

Why do the trial?

To compare the performance of 3 seeding systems and 2 nitrogen nutrition strategies. This is a rotation trial to assess the longer term effect of seeding systems and higher fertiliser input systems.

How was it done?

Plot size 35m x 13m

Seeding date Disc: 13th June
No-till: 13th June
Strategic: 15th June

Fertiliser DAP @ 50kg/ha
High nutrition No extra fertiliser applied

Medium nutrition No extra fertiliser applied

Variety Gunyah peas @ 100kg/ha

This trial is a randomised complete block design with 3 replicates, each containing 3 tillage treatments and 2 nitrogen nutrition treatments. The nutrition treatments were kept the same for the field peas in 2012. The strategic and no-till treatments were sown using local farmers Michael Jaeschke and Matt Dare's seeding equipment, respectively. The disc seeding treatment was sown by Andrew Bird from the South Australian No Till Association.

Table 1. Previous crops in the long term cropping systems trial at Hart.

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Sloop Barley	Canola	Janz Wheat	Yitpi Wheat	SloopSA Barley	Kaspa Peas	Kalka Durum	JNZ Wheat	JNZ Wheat	Flagship barley	Clearfield canola	Correll wheat

Tillage treatments:

Disc – sown into standing stubble with Serafin Baldan single discs on 250mm (10") row spacing, closer wheels and press wheels.

Strategic – worked up pre-seeding, sown with 100mm (4") wide points at 200mm (8") row spacing with finger harrows and then prickle chained.

No-till – sown into standing stubble in 1 pass with Flexicoil PD 5700 drill, narrow points with 300mm (12") row spacing and press wheels.

Nutrition treatments:

Medium – No extra fertiliser applied post seeding.

High – No extra fertiliser applied post seeding.

Soil nitrogen (0-60cm) was measured on 20th May in all plots.

For the plant counts, 4x1m sections of row were counted across each plot.

All plots were assessed for grain yield.

Results

Tillage treatments significantly influenced the grain yield of Gunyah peas in this trial at Hart in 2012 (Table 2). The no-till treatment yielded the highest again (1.11t/ha), followed by the disc (1.05t/ha) and strategic (0.92t/ha). However, there may also have been a time of sowing factor involved in these results as the no-till treatment was sown 2 days later than the other treatments.

There was no significant difference in grain yield between the two nutrition treatments.

Table 2. Grain yield (t/ha), available soil nitrogen (kg/ha) and crop emergence (plants per sq m) for nutrition and tillage treatments at Hart in 2012.

Nutrition	Tillage	Grain yield (t/ha)	Available soil nitrogen (kg N/ha)	Emergence (plants per sq m)
High	Disc	1.04	148	38
	No-till	1.14	143	28
	Strategic	0.91	125	30
Medium	Disc	1.06	94	32
	No-till	1.09	83	39
	Strategic	0.93	104	27
LSD (0.05)				
Tillage		0.11	ns	ns
Nutrition		ns	32.9	ns
Tillage * Nutrition		ns	ns	7.4

Soil available nitrogen to 60cm was measured in autumn and ranged between 83kg N/ha (no-till, medium) and 148kg N/ha (disc, high) between the tillage treatments (Table 2). There was no significant difference in available soil nitrogen between the tillage treatments.

The high nutrition treatments had accumulated 45kg N/ha more soil available nitrogen compared to the medium treatments to a depth of 60cm. These results are consistent with those measured in previous years, in 2011 the value was 28kg N/ha.

Crop emergence was variable for the no-till seeder, and the disc seeder produced the higher and most consistent plant numbers. This is opposite to the wheat crop emergence in 2011 where the disc plots were damaged by mice.

Yield Prophet® performance in 2012

Key findings

- Yield prophet accurately predicted a final grain yield near 2.2t/ha
- Predictions made in mid-August using an average finish to the season have been 80% accurate

Why do the trial?

Wheat growth models such as APSIM are highly valuable in their ability to predict wheat yield.

Yield Prophet® is an internet based service using the APSIM wheat prediction model. The model relies on accurate soil character information such as plant available water and soil nitrogen levels, as well as historical climate data and up to date local weather information to predict plant growth rates and final hay or grain yields.

The *Yield Prophet®* (YP) wheat growth model has been very accurate throughout Australia over the past 7 years in a range of soil types and seasons. At 4 sites in the Mid-North over the past 5 seasons YP has demonstrated this accuracy by providing accurate yield predictions with an average finish, in mid-August (Figure 1).

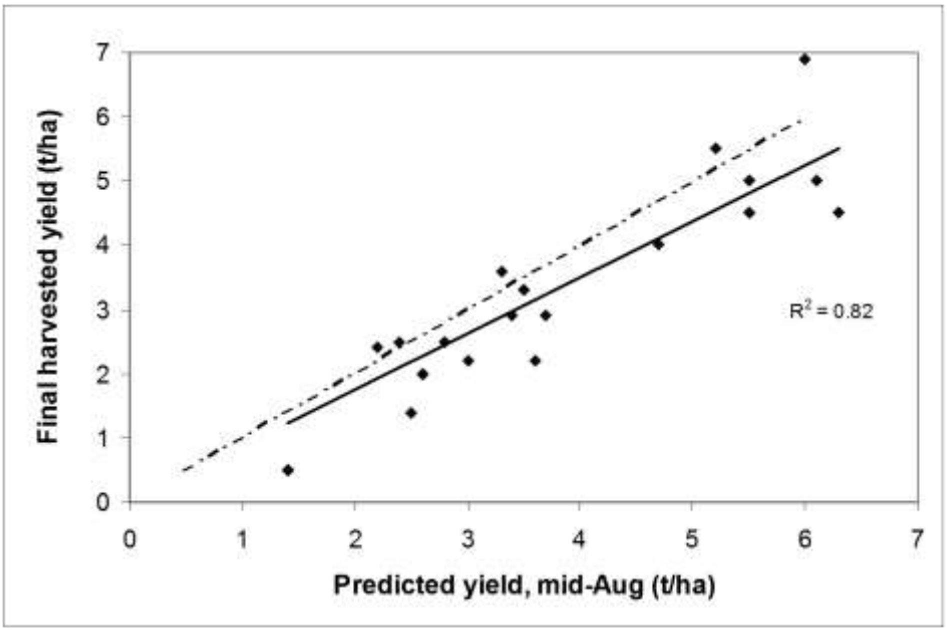


Figure 1: The relationship between predicted yield in mid-August, given an average finish to the season, against harvested grain yield. The sites and seasons include Spalding, Condowie, Tarlee (for 2009 to 2012), and Hart (2005 to 2012). The dashed trendline in the 1:1 line, through point 0.

This early prediction of grain or hay yield potential means it can be used to directly influence crop input decisions. No other tool is currently available to growers, which can provide information of this accuracy at such a useful time of the season.

While Yield Prophet does provide a very good guide for potential yield, Figure 1 shows that it tends to over estimate predicted grain yield in mid-August, compared to the 1:1 comparison line on the chart.

How was it done?

Seeding date	1st June 2012	**Fertiliser**	DAP @ 50kg/ha UAN @ 70L/ha 29th July
Variety	Gladius wheat @ 80kg/ha		

Soil samples were taken for soil nitrogen and moisture on the 18th May 2012.

Table 1. Soil conditions at Hart (0-90cm), 18th May 2012.

Available soil moisture	44 mm
Initial soil N	65 kg/ha

Yield Prophet® simulations were run throughout the season to track the progress of wheat growth stages and changes in grain yield predictions.

20%, 50% and 80% levels of probability refer to the percentage of years where the corresponding yield estimate would have been met, according to the previous 100 years of rainfall data.

Results

The grain yield for Gladius wheat sown on the 1st May at Hart in 2012 was 2.2t/ha. This final grain yield matched the Yield Prophet® prediction (Figure 2).

At the first simulation, 23rd June 2012, the Yield Prophet® simulation predicted that Gladius wheat sown on the 1st June would yield 3.5t/ha in 50% of years. The predicted grain yield was maintained up until mid-August, where it then decreased steadily due to below average spring rainfall and mild temperatures. The Yield Prophet® on the 8th October for grain yield, given an average (50%) finish to the season, was 2.0t/ha.

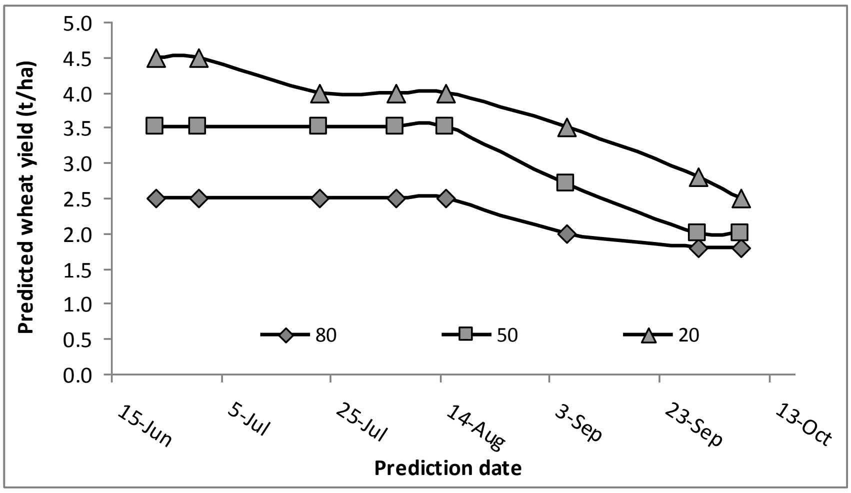


Figure 2: Yield Prophet® predictions from 15th June to the 13th October for Gladius wheat sown on the 1st June with 50kg/ha DAP. 80%, 50% and 20% represent the chance of reaching the corresponding yield at the date of the simulation.

At time of sowing, plant available water (PAW) measured 44mm (0-90cm) due to reasonable levels of stored moisture from spring (2011) and summer (2012) rains. PAW increased significantly up until the end of July and then dropped due to a lack of rain. With greater crop use and higher temperatures, it dropped to below 10mm PAW by the end of October. Fortunately temperatures did not exceed 30°C and enabled crops to fill good quality grain.

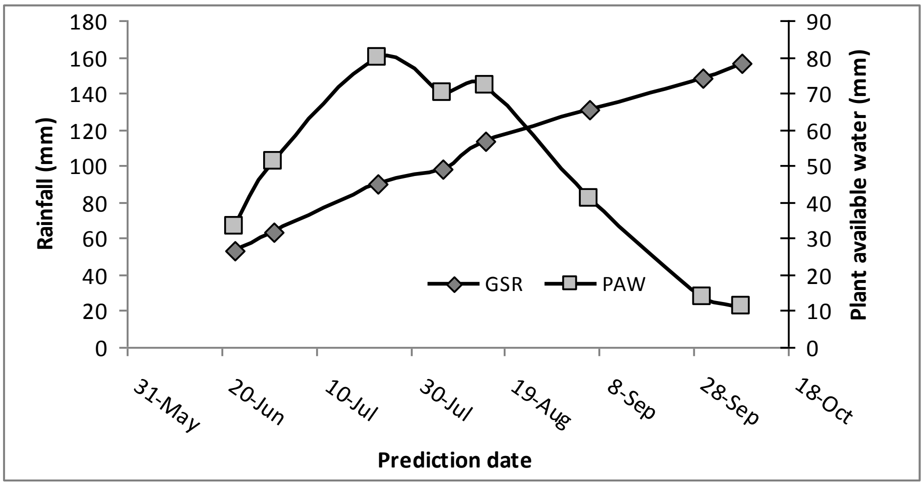


Figure 3: Predicted plant available water and recorded cumulative growing season rainfall from 20th June to the 15th October at Hart in 2012.

Michael Jaeschke, Allan Mayfield, Kevin Jaeschke and Matt Dare at the 30th Annual Hart Field Day, 2012

Increasing economic returns of agronomic management using precision agriculture

Michael Wells PCT, Peter Treloar and Felicity Turner

Key findings

- EM38 successfully mapped differences in soil water properties across the paddock
- There were no significant yield increases from increased fertiliser
- Reducing fertiliser on heavy soils had no negative impact on yield

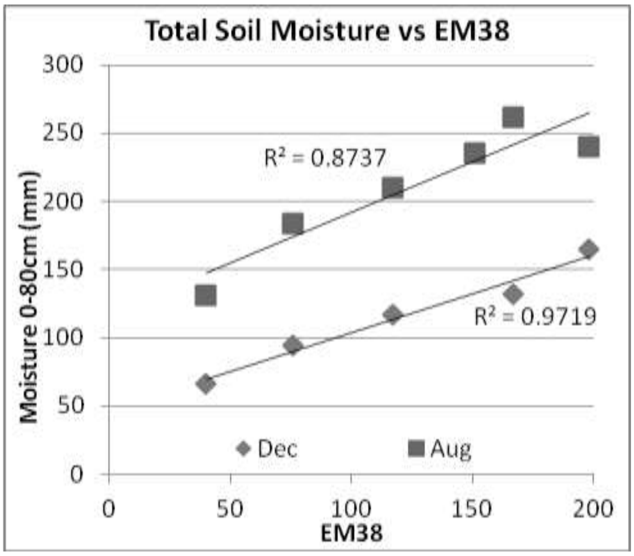
Why do the trial?

EM38 soil surveying has been available in SA for many years, with varying levels of success in different regions. Gamma Radiometrics is another form of soil surveying that has been used in WA for many years and has been particularly successful in conjunction with EM38.

A 3 year project, funded by SAGIT, to investigate the use of Gamma Radiometrics in SA began in 2011. Five sites were established across SA - Edillilie, Kimba, Hart, Coomandook and Padthaway.

What happened in 2012

EM38 and Soil Moisture



Targeted soil moisture sampling at the end of 2011 illustrated a strong correlation between crop lower limit and EM38.

Sampling was repeated in August 2012, when the profile was estimated to be relatively full.

This again correlated well with EM38, indicating a potential to use EM38 zones to manage inputs.

As a result simple maps consisting of 3 Zones were generated based on EM38.

Fertiliser strips were placed across the zones in two paddocks, each trial consisted of 3 rates with two replicates. The strips consisted of +/- 50% of the base 140kg/ha of 27:12.

These trial strips were very clear early in the season but with the very dry spring they gradually merged with the rest of the paddock.

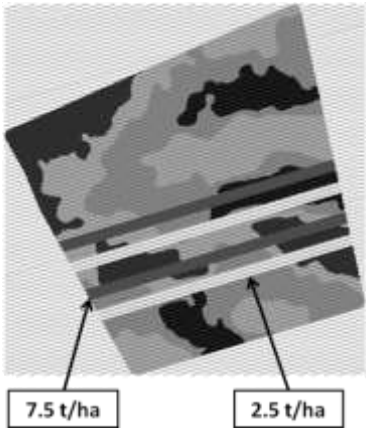
Tissue testing was conducted on each rate and zone, as well as repeating DGT Phosphorus tests at each site. The major findings of the tissue testing were:

- Decreasing calcium as EM38 increases
- Large increases in chloride and sodium in the highest EM zone
- Low phosphorus and plant growth in lowest EM zone
- Increased nitrate levels with increased fertiliser

Trials Established in 2012

Seeding fertiliser trial (left): Repeated stripes +/- 50% of the base 140kg/ha of 27:12.

Long term gypsum trial (below): High and low rates of gypsum through different levels of sodicity.



Results

Early season observations showed a likely response to fertiliser across the different soil types. But as the dry spring continued these differences reduced. Protein was not collected.

Table 1. Grain yield (t/ha) response to fertiliser rate (27:12) and paddock EM zone on commercial paddocks near Hart in 2012.

	Paddock 5			**Paddock 6**		
Rate	Low EM	Med EM	High EM	Low EM	Med EM	High EM
70	***3.52***	3.98	3.82	***2.51***	3.08	3.10
140	***3.61***	3.95	3.88	***2.80***	3.01	3.14
200	***3.73***	4.02	3.82	***2.72***	3.00	3.11

The low EM zones produced the lowest yield in both paddocks, but in the lower yielding Paddock 6 there was a decrease in yield from extra fertiliser.

In Paddock 5 there was a slight trend of increased yield from increased fertiliser, unfortunately the increase was not economic as the extra yield did not pay for the extra fertiliser. This meant the most economic rate all three zones in both paddocks was 70 kg/ha.

Conclusions:

EM38 has shown a strong correlation to historic yield and soil properties at Hart, indicating the potential to base long term management zones on EM38.

While no positive result was observed for increasing fertiliser, no negative results were seen for reducing fertiliser on the heavier soils. This was a common outcome across the state in other trials in 2012 due to the very dry spring.

These trials will be continued and further refined in 2013, including in crop nitrogen.

Variable rate nitrogen: making dollars and sense

Key findings

- In 2011 optimised variable rate N applications increased gross margins by $11-$22/ha in two barley crops.
- In 2012 variable rate N applications increased gross margins by $13-$20/ha in three wheat crops, based on yield response and fertiliser savings.
- Increases in grain protein of 0.3 – 0.5% have been observed.

Why do the trial?

To assess the economic benefit of variable rate nitrogen application, when combined with crop sensor information and yield potential zones to build the variable rate application map.

How was it done?

There are a number of different data layers available that provide information on paddock variability. Information from crop sensors is useful, because it provides a snapshot of how the crop is performing in the current season (Figure 1). This information can be used to produce variable rate application maps for nitrogen (N). However, this assumes that all variability observed is due to variability in N availability, and that the whole paddock has the same yield target. However, we know that this is often not true.

Variability in crop growth can be caused by other constraining factors, and historical yield data tells us that there are usually different yield potentials in zones across paddocks (Figure 2). So, how can we account for this?

In this paddock at Hart N rich strips have been put out across the paddock zones (Figure 3). The N rich strips were put out as UAN with a 2m boom after the crop was sown. The rate was 180L/ha. The N rich strip is important for indicating whether the crop is responsive to N or not and provide a reference for the rest of the crop, this is termed the response index (RI). The response index (RI) is calculated from referencing the N rich NDVI against the adjacent paddock NDVI. Interpretation of N rich strips is explained in Table 1. This paddock is a good example, where low NDVI (Figure 1) in zones 2 & 3 (Figure 2) have different levels of N response (Figure 3). Zone 3 has other constraints limiting crop growth, so whilst having low NDVI, the N response is lower than that observed in low NDVI regions of zone 2.

These three data layers were combined to produce an N application map (Figure 4). The variable rate map recognises that there are zones of differing yield potential, but also that there is variation within the zones, as picked up by the crop sensors. This N application map was applied on August 22nd, the average application being 35kg Urea/ha. To test this theory, constant rate strips of 70kg Urea/ha were applied across the paddock for comparison, as highly replicated strips. These were harvested with a yield mapping equipped harvester to assess the benefit of variable rate application (VR) over constant rate. This method was used in three wheat crops in 2012 at Hart, Bute and Marrabel. The rate calculations at Bute resulted in 20kg Urea/ha more being applied to the VR treatment compared with the growers constant of 100kg Urea/ha, while at Marrabel both treatments received the same rate of urea.

Results

There were no yield differences observed between VR and constant treatment at Hart. However 35kg Urea/ha less was used in the VR treatment resulting in a gross margin benefit of $20/ha. The results for Marrabel and Bute found that on average this method of variable rate N application resulted in a 60 and 80kg/ha yield increase, respectively. This is equivalent to $13-$18/ha benefit when the extra urea is costed in for the Bute trial. This is not a uniform response across these paddocks. Yield maps were generated for the variable rate nitrogen (VRN) treatment (Figure 5) and the uniform treatment (Figure 6). The yield map resulting from uniform N was then subtracted from the yield map resulting from VRN, to generate the difference map (Figure 7).

Similar numbers were generated for barley in 2011, with optimal VRN applications returning $11-22/ha more than uniform N applications.

Earlier work found that protein increases of 0.3-0.5% can be observed in response to VRN applications compared with uniform rate applications. Where grade spreads such as APW wheat are based on 1% protein increments, this equates to a 30-50% chance of increasing the grade achieved for that crop.

These results illustrate that when it comes to varying nitrogen rates you cannot have your cake and eat it too. Variable rate will either distribute the same or more fertiliser to achieve more yield than current uniform practice in N responsive sites, or can result in an input saving, but no increase in yield, at non responsive sites. To achieve large yield gains from VRN implies that current management practice is under fertilising large areas of a paddock. Generally, farmers are currently selecting blanket fertiliser rates that maximise yield potential across the majority of the paddock, possibly 80% or more of the paddock. Consequently, that only leaves about 20% of the paddock to achieve increased yield when supplied with increased fertiliser rates.

So when considering using variable rate in-crop nitrogen it is worth recognising where the economic benefits are likely to be realised. If you under fertilise the majority of the paddock then substantial yield gains may be achieved, but if you maximise yield across most of the paddock you are looking for cost savings where the crop is over fertilised. The only instance where fertiliser savings and yield gains can be achieved at the same location is when over fertilisation leads to haying off and reduced yields. Therefore, establishing the proportion of crop that will be nitrogen responsive and the degree of responsiveness is useful. This information will support decisions on whether nitrogen should or should not be applied and at what rate. It can then support decisions about varying rates and the likely economic benefit in different zones, be they input saving or yield maximisation depending on current uniform applications.

Table 1. Interpretation of N response observed in the N rich strip compare with normal crop growth (non N rich).

	Low N response	**High N response**
Low crop vigour	Indicates the lack of vigour is due to a constraint other than nitrogen. Suggest a tissue test to determine if any other nutrients are limiting or soil testing to ascertain what the constraints are.	Indicates the lack of vigour is due to N and higher rates of N should be applied to these crops or areas of crop.
High crop vigour	Indicates that crop is not responsive to N at the time of assessment but the crop is in good health. Continue to monitor these sites, as it may become responsive later in the season as it depletes soil N reserves.	Indicates crop is responsive to N. Given the good growth of the paddock managed crop assess soil moisture availability before applying more N, as the crop may have grown enough bulk to maximise yield without additional N.

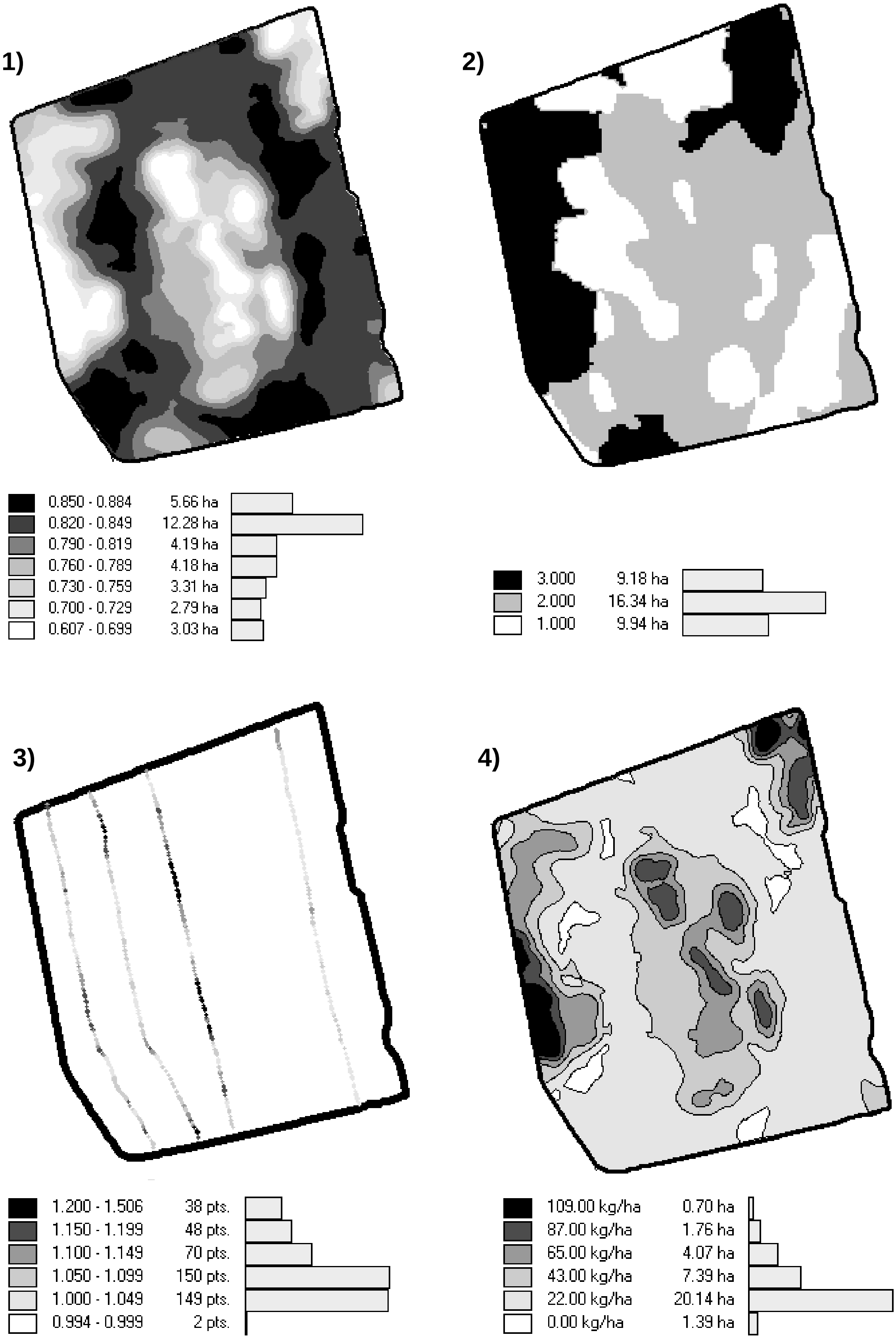


Figure 1) Greenseeker NDVI measured on August 7th 2012 at Hart, 2) Zone map based on historical yield and EM38 data, 3) Response Index (RI) calculated from the Greenseeker

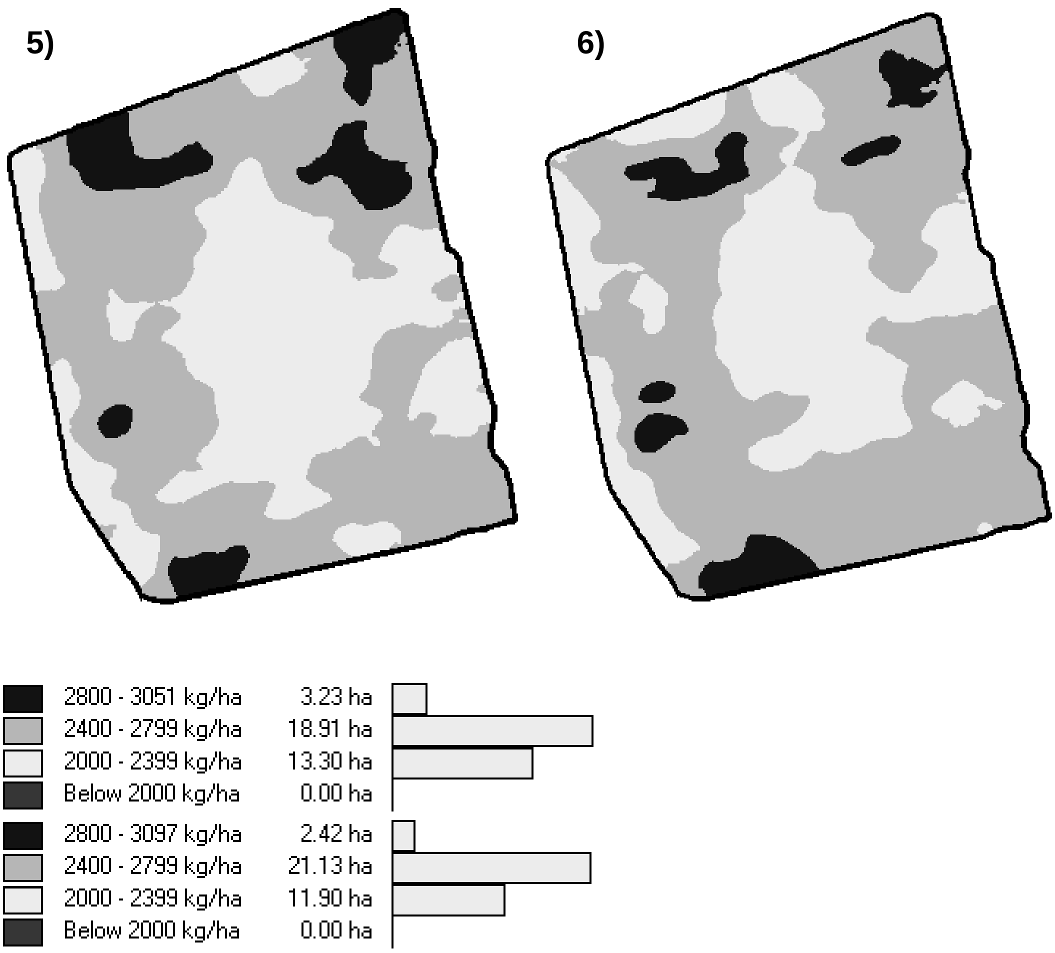


Figure 5) Hart paddock yield with VRN treatment, 6) Hart paddock yield with uniform N treatment, 7) Hart paddock yield difference between VRN and uniform treatment. On average there is no yield difference, but 35 kg urea/ha less was used on the VRN treatment.

Site specific plant growth regulators at Bute, 2011

Key Findings:

- Significant reduction in height of both wheat and barley to an application of Moddus and Cycocel.
- No yield responses observed to plant growth regulator application in either wheat or barley.

Why do the trial?

To assess the effect of plant growth regulators on wheat and barley yield at Bute in different paddock production zones.

How was it done?

Plot size	36m boom width and length of paddock	**Fertiliser**	DAP @ 100kg/ha

In 2011 two plant growth regulant treatments were applied to wheat (Correll) and barley (Fleet) and compared with nil. The treatments were applied with the growers boom spray with strips the full length of the paddock applied on August 11th 2011 when the crops were at GS31.

The two paddocks had three treatments applied. These were

1. Cycocel @ 1L/ha + Moddus @ 200mL/ha @ GS31
2. Cycocel @ 1L/ha @ GS31
3. Nil

Measurements of crop growth (NDVI) were made from an aeroplane in late August and measurements of crop height were made at harvest time. Yield differences were measured using the harvester yield monitor.

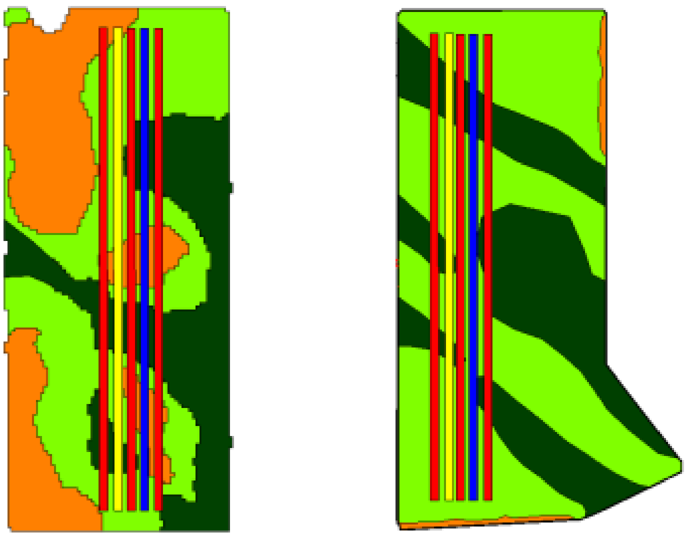
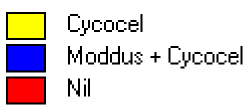


Figure 1: Layout of PGR treatments across production zones in two paddocks at Bute. Ronnies paddock (on left) was sown to Fleet barley. Race paddock (on right) was sown to Correll wheat.



Results

The treatment of Moddus + Cycocel had the greatest growth regulant effect, reducing the height of wheat by 5-10cm and barley by 10-14cm (Table 1) and was visually obvious at ground level and also in the aerial imagery (Figure 2a & d). Cycocel applied alone provided only a small growth regulant effect and was not visually obvious.

Table 1. Crop height measurements (cm) at maturity for wheat and barley on two soil types.

Crop	Zone	Nil	Cycocel	Moddus + Cycocel
Wheat	Loam flat	73.6	72.3	68.7
Wheat	Sand hill	86.3	82.0	76.6
Barley	Loam flat	76.5	73.1	62.1
Barley	Sand hill	71.7	74.9	60.4

Yield differences between treatments were not significant for most of the zones along the trial strips, with little difference observed between the growth regulant treatments and nil, any yield gains were inconsistent and small. In Ronnies paddock (barley) there were some yield reductions observed with the growth regulant treatments on the southern end of the trial. These were significant and more pronounced in the Moddus + Cycocel treatment, with a yield reduction of 0.2-0.3t/ha. Given the high cost of these treatments (approx $45/ha for Moddus + Cycocel) and the negative yield effect in some areas the application of growth regulants in the Bute region appears limited, and would have made a loss in season 2011. Had the crop not endured a 6 week dry spell shortly after the growth regulant application the results may have been different, however the final paddock yields were still average for the district, so the crops were not under drought conditions. Potentially in a higher yielding season (> decile 7) there may still be a benefit from the use of growth regulants in this region.

It was expected that the benefits of the growth regulants would be related to the amount of crop growth. It was expected they would have a greater beneficial impact where the crop was identified as being thick and bulky, according to the aerial imagery and that the effects would be less or negative where crop growth was less and possibly already constrained by other factors such as nutrition. If this were correct, crop imagery could be used to target growth regulants to areas where a positive response is most likely. There was lower NDVI at the southern end of Ronnies paddock, and this is where a negative yield response was observed, indicating the hypothesis may be correct, however the link is not strong.

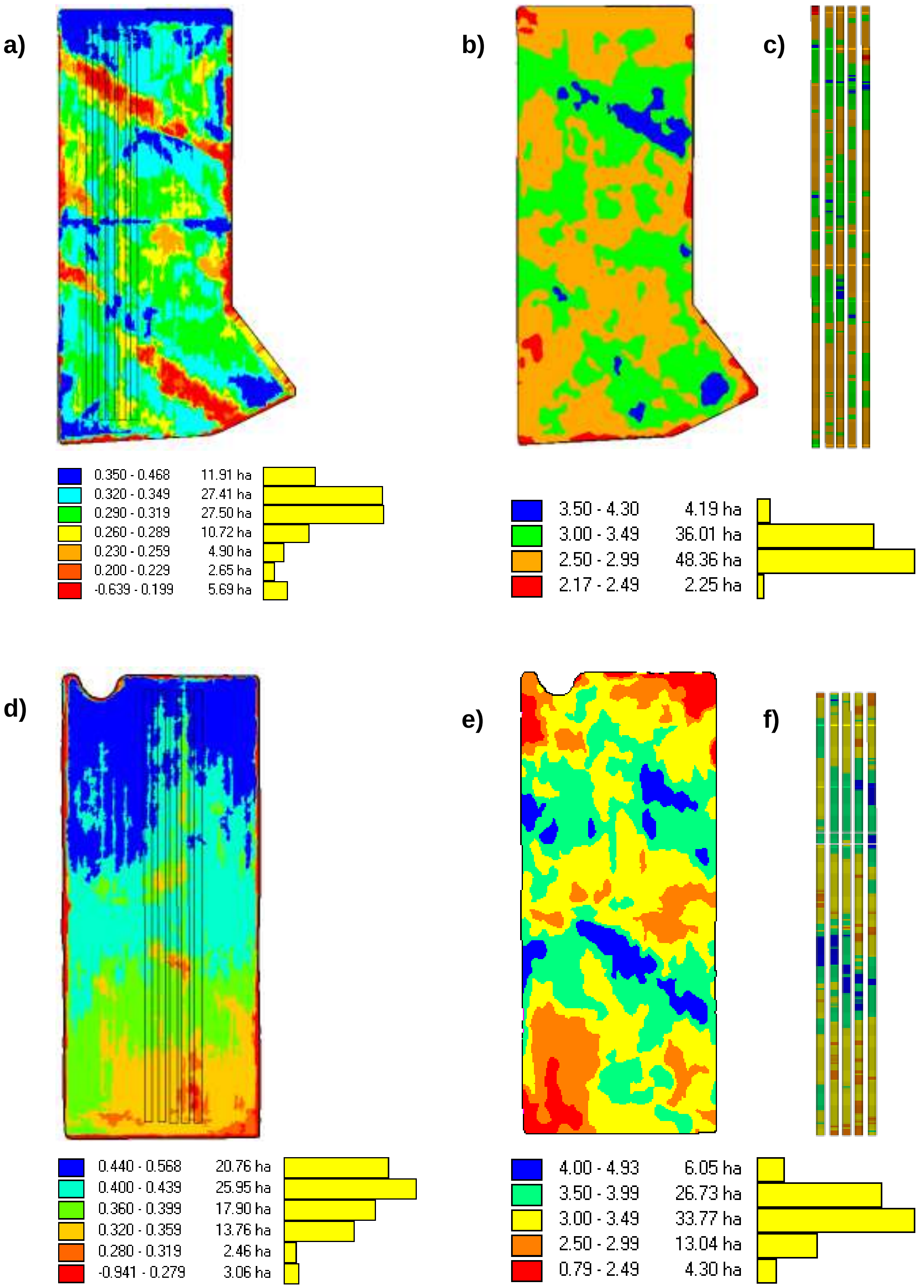


Figure 2 a) Aerial image (NDVI) of Race paddock collected on 29/8/2011, b) wheat yield (t/ha) map for Race paddock, c) yield of individual trial strips in Race paddock, d) Aerial image (NDVI) of Ronnies paddock collected on 29/8/2011, e) barley yield (t/ha) map for Ronnies paddock, f) yield of individual trial strips in Ronnies paddock.

Site specific plant growth regulators at Marrabel, 2011

Key Findings:

- Significant yield response to plant growth regulant application in barley, except where water logging occurred.

Why do the trial?

To assess the affect of plant growth regulators on barley yield at Marrabel in different paddock production zones.

How was it done?

Plot size	32m boom width and length of paddock	**Fertiliser**	DAP @ 100kg/ha

In 2011 one plant growth regulant treatment was applied to Commander barley and compared with nil. The treatments were applied with the growers boom spray with strips the full length of the paddock applied when the crop was at GS31.

The paddock had two treatments applied. These were:

1. Cycocel @ 1L/ha + Moddus @ 200mL/ha @ GS31
2. Nil

Yield differences were measured using the harvester yield monitor.

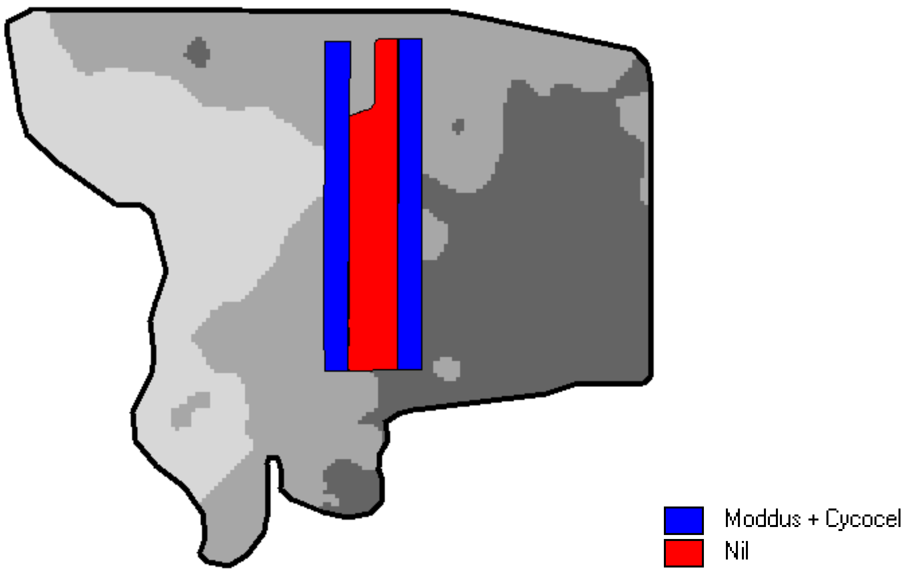


Figure 1: Layout of PGR treatments across production zones in a Commander barley paddock at Marrabel.

Results

Yield differences between treatments were highly significant (Figure 2c). Differences observed between the growth regulant treatments and nil were up to 0.5t/ha along the trial strip. The yield differences were not significant at the northern end of the trial strips, this is where localised waterlogging was observed in the trial and crop growth was reduced before the growth regulants were applied, as observed in the crop spec data (Figure 2a).

Given the high cost of these treatments (approx $45/ha for Moddus + Cycocel), at $200/t a 0.45t yield increase is required to give a 2:1 return on the input costs. This was achieved in most zones, except where the crop was poorer due to waterlogging. This was observed at the northern end of the trial site. The Crop Spec sensor was able to detect these areas of poorer crop. This Crop Spec sensor information could be used in future years to target PGR's site specifically only to crop where a significant response is likely.

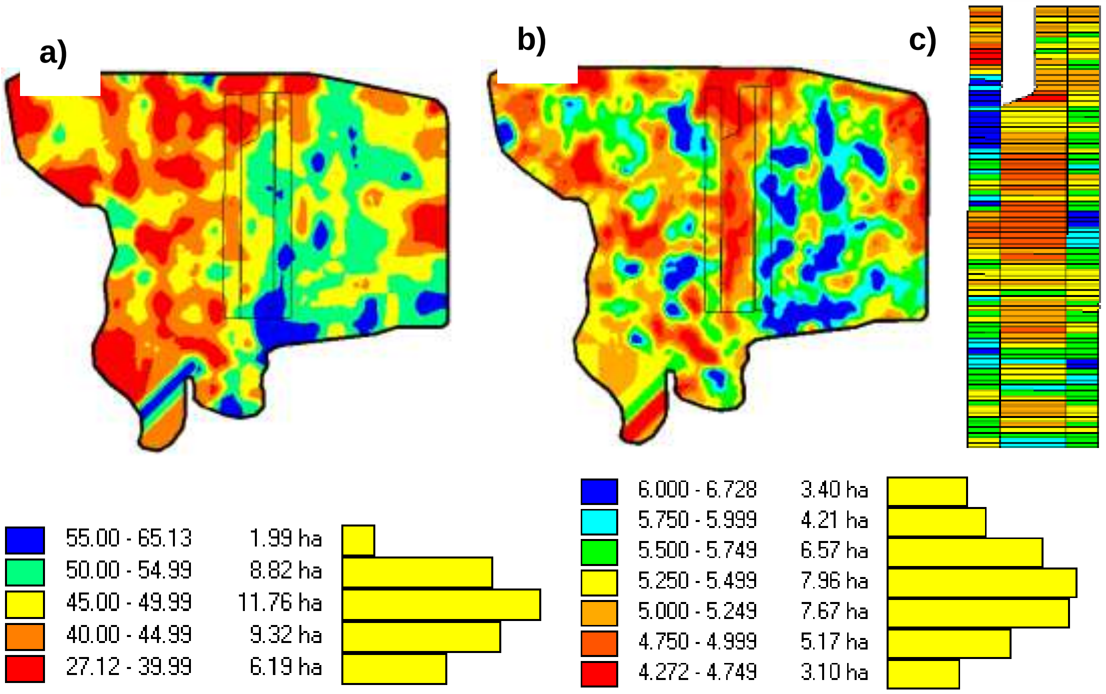
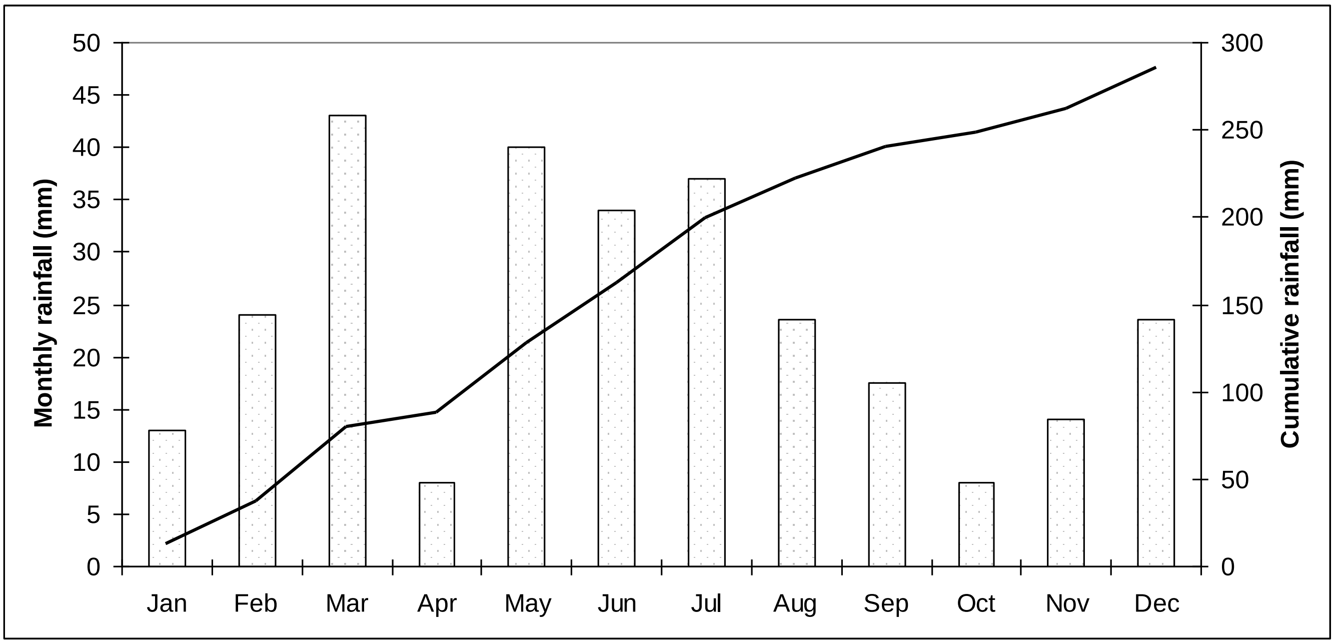


Figure 2 a) Crop Spec sensor image collected on 1/9/2011, b) barley yield (t/ha) map, c) yield of individual trial strips

Rainfall, Hart 2012

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1			22.0				3.0					21.5
2					6.0	2.0						
3												
4						2.0						
5											3.0	
6		2.0										
7									7.0			
8	12.0							2.5				
9												
10							11.0					
11										7.0		
12												
13							15.0		6.0			
14												
15			10.0			3.0						2.0
16												
17								12.0				
18												
19												
20					5.0							
21			9.0									
22						23.0						
23		3.0										
24	1.0							9.0				
25			2.0	8.0						1.0		
26					29.0						2.5	
27												
28							8.0				8.5	
29		19.0				4.0			4.5			
30												
31												
Monthly total	13.0	24.0	43.0	8.0	40.0	34.0	37.0	23.5	17.5	8.0	14.0	23.5
Running total	13.0	37.0	80.0	88.0	128.0	162.0	199.0	222.5	240.0	248.0	262.0	285.5



Average GSR (Apr-Oct)	305 mm	Average rainfall	400 mm
2012 GSR (Apr-Oct)	168 mm	2012 total rainfall	286 mm
2012 GSR (Apr-Oct)+summer	193 mm		

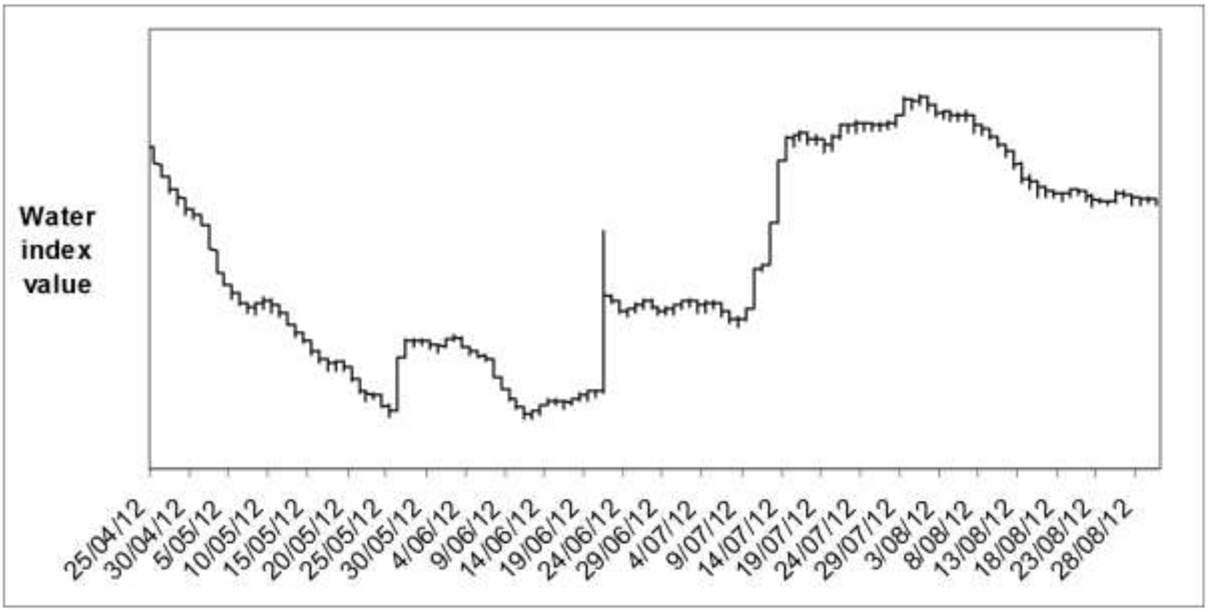
Soil test Hart trial site 2012

March 2010 – Northern quarter

Depth (cm)	**0 - 10**
Phosporus (ppm) (Cowel P)	52
Potassium (ppm)	579
Salinity (EC dS/m)	0.14
Organic carbon (%)	1.80
pH (calcium chloride)	7.4
pH (water)	8.2
Phosphorus buffering index	97
Phosphorus DGT test	70

Available soil moisture 21st May (0-90cm)	44 mm	**Soil nitrogen 21st May (0-90cm)**	65kg N/ha

Hart soil water in 2012



The change in soil water at Hart (as a relative index, not actual mm) between April 2012 and August 2012. It is being continually measured by an Adcon Telemetry Advantage Pro moisture probe, and is positioned under the commercial crop, down to 90cm.

Notes